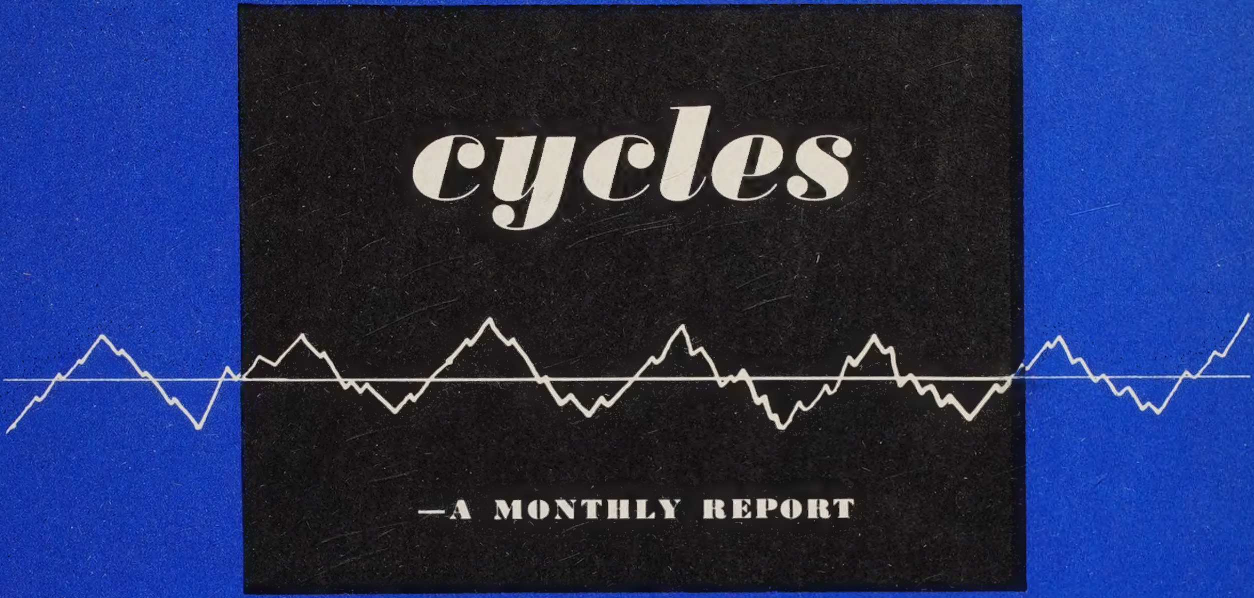


cycles

—A MONTHLY REPORT

November 1951

FOUNDATION FOR THE STUDY OF CYCLES
New York, New York

STANDARD QUARTER-YEAR NUMBERS

Just as month numbers are almost indispensable in the cycle analysis of monthly data, so also quarter year numbers are of the greatest possible assistance in dealing with quarterly data.

The quarter year numbers that we use are given in the table below. The fourth quarter in 1650 is base 0. In dealing with short series of figures you can, if you wish, subtract 1000 from each of the numbers starting with the fourth quarter of 1900.

You will notice that the number given for the fourth quarter of each year, starting 1901, is 1000 plus four times the value of the last two digits of the year. Thus the number for the fourth quarter of 1911 is 4 × 11, or 44, + 1000, or 1044.

Conversely, quarter number 1200 would represent the fourth quarter of 1950 (1200 − 1000 = 200; 200 ÷ 4 = 50). Quarter number 1202 would be the second quarter of 1951--two quarters after the fourth quarter of 1950 (1202 − 1000 = 202; 202 ÷ 4 = 50 plus a remainder of 2).

Quarter numbers are needed for time charts, for periodic tables, and for a variety of other manipulations of quarterly data.

Our system of quarter year numbers was developed by Alexander Malinowski, Sr., of the Foundation staff.

YEAR	1st	2nd	3rd	4th
1830	717	718	719	720
1831	721	722	723	724
1832	725	726	727	728
1833	729	730	731	732
1834	733	734	735	736
1835	737	738	739	740
1836	741	742	743	744
1837	745	746	747	748
1838	749	750	751	752
1839	753	754	755	756
1840	757	758	759	760
1841	761	762	763	764
1842	765	766	767	768
1843	769	770	771	772
1844	773	774	775	776
1845	777	778	779	780
1846	781	782	783	784
1847	785	786	787	788
1848	789	790	791	792
1849	793	794	795	796
1850	797	798	799	800
1851	801	802	803	804
1852	805	806	807	808
1853	809	810	811	812
1854	813	814	815	816
1855	817	818	819	820
1856	821	822	823	824
1857	825	826	827	828
1858	829	830	831	832
1859	833	834	835	836
1860	837	838	839	840
1861	841	842	843	844
1862	845	846	847	848
1863	849	850	851	852
1864	853	854	855	856
1865	857	858	859	860
1866	861	862	863	864
1867	865	866	867	868
1868	869	870	871	872
1869	873	874	875	876
1870	877	878	879	880
1871	881	882	883	884
1872	885	886	887	888
1873	889	890	891	892
1874	893	894	895	896
1875	897	898	899	900
1876	901	902	903	904
1877	905	906	907	908
1878	909	910	911	912
1879	913	914	915	916
1880	917	918	919	920
1881	921	922	923	924
1882	925	926	927	928
1883	929	930	931	932
1884	933	934	935	936
1885	937	938	939	940
1886	941	942	943	944
1887	945	946	947	948
1888	949	950	951	952
1889	953	954	955	956
1890	957	958	959	960
1891	961	962	963	964
1892	965	966	967	968
1893	969	970	971	972
1894	973	974	975	976
1895	977	978	979	980
1896	981	982	983	984
1897	985	986	987	988
1898	989	990	991	992
1899	993	994	995	996
1900	997	998	999	1000
1901	1001	1002	1003	1004
1902	1005	1006	1007	1008
1903	1009	1010	1011	1012
1904	1013	1014	1015	1016
1905	1017	1018	1019	1020
1906	1021	1022	1023	1024
1907	1025	1026	1027	1028
1908	1029	1030	1031	1032
1909	1033	1034	1035	1036
1910	1037	1038	1039	1040
1911	1041	1042	1043	1044
1912	1045	1046	1047	1048
1913	1049	1050	1051	1052
1914	1053	1054	1055	1056
1915	1057	1058	1059	1060
1916	1061	1062	1063	1064
1917	1065	1066	1067	1068
1918	1069	1070	1071	1072
1919	1073	1074	1075	1076
1920	1077	1078	1079	1080
1921	1081	1082	1083	1084
1922	1085	1086	1087	1088
1923	1089	1090	1091	1092
1924	1093	1094	1095	1096
1925	1097	1098	1099	1100
1926	1101	1102	1103	1104
1927	1105	1106	1107	1108
1928	1109	1110	1111	1112
1929	1113	1114	1115	1116
1930	1117	1118	1119	1120
1931	1121	1122	1123	1124
1932	1125	1126	1127	1128
1933	1129	1130	1131	1132
1934	1133	1134	1135	1136
1935	1137	1138	1139	1140
1936	1141	1142	1143	1144
1937	1145	1146	1147	1148
1938	1149	1150	1151	1152
1939	1153	1154	1155	1156
1940	1157	1158	1159	1160
1941	1161	1162	1163	1164
1942	1165	1166	1167	1168
1943	1169	1170	1171	1172
1944	1173	1174	1175	1176
1945	1177	1178	1179	1180
1946	1181	1182	1183	1184
1947	1185	1186	1187	1188
1948	1189	1190	1191	1192
1949	1193	1194	1195	1196
1950	1197	1198	1199	1200
1951	1201	1202	1203	1204
1952	1205	1206	1207	1208
1953	1209	1210	1211	1212
1954	1213	1214	1215	1216
1955	1217	1218	1219	1220
1956	1221	1222	1223	1224
1957	1225	1226	1227	1228
1958	1229	1230	1231	1232
1959	1233	1234	1235	1236
1960	1237	1238	1239	1240
1961	1241	1242	1243	1244
1962	1245	1246	1247	1248
1963	1249	1250	1251	1252
1964	1253	1254	1255	1256
1965	1257	1258	1259	1260
1966	1261	1262	1263	1264
1967	1265	1266	1267	1268
1968	1269	1270	1271	1272
1969	1273	1274	1275	1276
1970	1277	1278	1279	1280
1971	1281	1282	1283	1284
1972	1285	1286	1287	1288
1973	1289	1290	1291	1292
1974	1293	1294	1295	1296
1975	1297	1298	1299	1300
1976	1301	1302	1303	1304
1977	1305	1306	1307	1308
1978	1309	1310	1311	1312
1979	1313	1314	1315	1316

cycles

—a monthly report

The Official Bulletin of the Foundation for the Study of Cycles

VOLUME II NUMBER 9 NOVEMBER 1951

The Director's Letter

Dear Member:

Mrs. Roessle, who jollies your money out of you and who attends to the membership plan generally, has recently finished the second of two very successful direct mail campaigns for new members.

Results are most gratifying. We added about 100 new regular members and about 900 trial members. But we do not yet know how many of the trial members will put their shoulders to the wheel and send in $10 or more to help defray expenses for the coming year.

I hope many of them will because we need the financial support.

Also, in a broader and deeper sense, we need their moral support, if they are interested in what we are trying to do. The job before us is too big for any one man or any handful of men. We need a sizable body of loyal, interested men and women who, banded together within the framework of the Foundation, will each do what he or she can—statistically, financially, or otherwise—to help the work along.

It is not often that a group of people have the opportunity to be in on the birth of a new science, for that of course is what the study of cycles, as a subject by itself, is.

Some of our new trial members may not like our monthly reports. For such, and for you too, we have provided a means of improving them. On pages 355 and 356 of this issue there is a questionnaire on which you and they can register your likes and dislikes. Fill in the form, tear it out, and mail it in. It will take only a few minutes time and cost you only a 3¢ stamp. Do this even if you like the reports the way they are. For, if you like them, we need the weight of your vote to offset the votes of people who wish to have things turned upside down and inside out. It is your Foundation you know, and your report, and you might just as well have things the way you want them.

●

Wars and Depressions

If we are to control wars and depressions we must know their causes—not merely think we know. If the ups and downs of business and wars and human behavior generally are cyclic, this cyclic behavior must have a cyclic cause or cyclic causes. Until we understand the working of this cause or these causes we can never hope to evaluate the result of any given remedy for our ills, or any given social, political, or economic program or party. Until we understand the effect of cycles we may blame a political party for an economic catastrophe for which it was in no way responsible; we may praise a popular president for an economic recovery which would have come about anyway, perhaps more quickly and better if he had not tried to help it along.

Without a knowledge of cycles, we are like the Moor of whom Sir James G. Frazer speaks in **The Golden Bough.** " When a Moor has a headache he will sometimes take a lamb or a goat and beat it till it falls down, believing that the headache will thus be transferred to the animal. "

The main tragedy of this situation is not that some innocent president or party is made the goat and beaten and driven out of office. The tragedy is that the people believe that such actions have value in curing a condition which may be brought about by purely cyclic forces.

The Moor beats his goat at the end of his headache and gets better. Next time—if he can catch the goat—he beats him at the beginning of the headache, but it doesn't help. He would be better advised to learn the cause of his headaches and prevent them, and so would we.

●

Why Human Beings Respond to Cycles

It should be fairly obvious that whenever human beings and animals respond to cyclic forces in their environment it is because, through natural selection, those creatures which have learned to respond to such forces stand a better chance of survival than those creatures which have not.

It is easy to see why creatures which have learned to respond to sound waves and to light waves stand a better chance of survival, but why will an animal or a human being benefit by responding to environmental forces which pulsate in wave lengths of several months or several years?

As yet no one knows the answer, but we may have more than a hint in a passage brought to my attention by Laurence K. Arthur, Assistant Manager of the Louisville Branch of the Federal Reserve Bank of St. Louis, one of our members. This passage is to be found on page 54 of **Yours to Venture** by Robert R. Updegraff, published in New York by Whittlesey House, and reproduced with permission. It reads as follows:

A story by Gladstone

" The late Mr. W. E. Gladstone gave a speech to the effect that during the old coaching days he used to enquire from the coaches that went out from London whether the road through Highgate, Barnet and St. Albans to the north of England, and what is known as the Holyhead Road, was not hard on the horses, and whether the alternative road, which goes along through Slough and Oxford and which is fairly level, was not better. He was surprised to find that the horses on the Highgate Road lasted half again as long as the horses on the level Slough Road, from which he drew the inference that it was variety and change, up hill and down valley, collar-work at one point and no collar-work at another, that was best for the health of a horse, and in his experience best for the health of a man. "

Could this be the answer? What do you think? I think it is.

●

The other day I happened to read the baccalaureate address of Dr. Reinhold Niebuhr given at the commencement exercises at Dartmouth College in June of 1951.

His closing words are so appropriate to the study of cycles that I am going to quote them for you here: . . . " Nothing that is worth doing can be accomplished in your lifetime; therefore you will have to be saved by hope. Nothing that is beautiful will make sense in the immediate instance; therefore you must be saved by faith. Nothing that is worth doing can be done alone, but has to be done with others; therefore you must be saved by love. "

Very cordially yours,

Edward R. Dewey

Director

THE 41-MONTH CYCLE IN INDUSTRIAL COMMON STOCK PRICES

Summary

A cycle of about 41 months has been present in industrial common stock prices from their beginning in 1871 to date. Discovered in 1912, it has continued for 39 years since discovery. Its average length for the past 80 years has been about 40.7 months or 3.39 years. The important task ahead is to know in advance when it will be strong, when weak; when it will come early and when late.

ONE of the most important cycles present in industrial common stock prices from 1871 forward is a cycle which has averaged about 41 months in length.

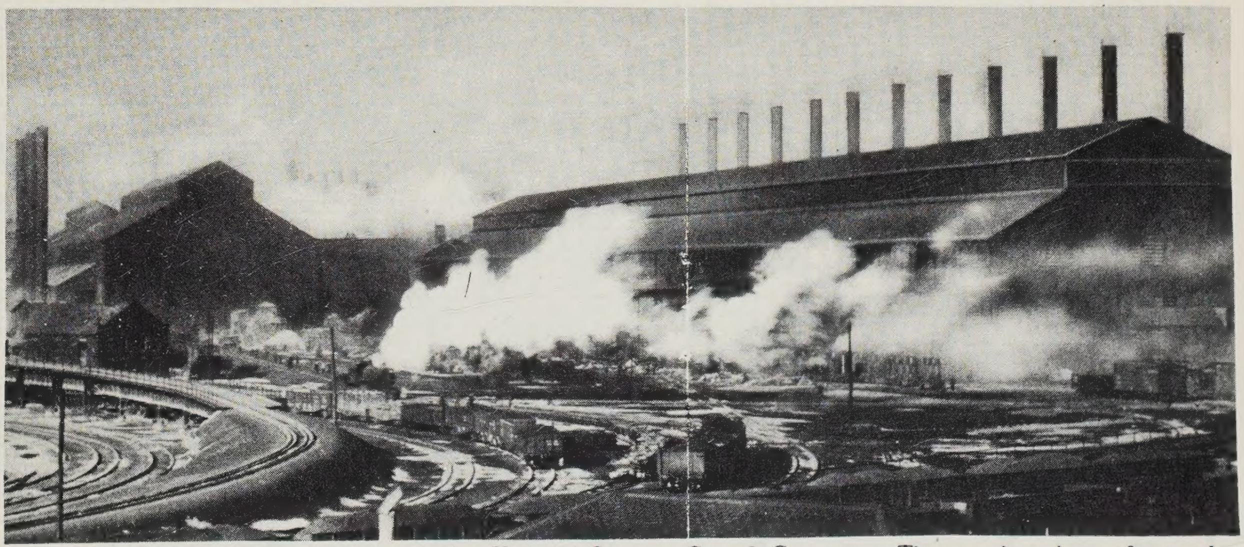
This tendency for the prices of industrial common stocks to go up and down in waves with a period (length) of about 41 months was first observed in 1912.

The cycle has continued for the 39 years that have elapsed since its discovery, thus seeming to prove beyond a doubt (although of course not without a doubter) that the behavior is not the result of random forces.

Cycle discovered in 1912

The discovery of this cycle in 1912 was made at the instance of a New York group who had heard that the Rothschilds had plotted British Consuls and had broken up their fluctuations into a series of repeating curves which, when combined, they used as a forecasting curve.

The New York group employed a mathematician to discover the formula. He plotted the Dow-Jones Railroad Averages, and broke them up into the 41-month cycle and three other cycles, the formulas for which he expressed in sine-cosine form. The mathematician combined these curves into a forecast which he turned over to his employers.



The Gary Indiana Works of the United States Steel Company. The production of steel, like the prices of industrial common stocks, shows a 41-month cycle.

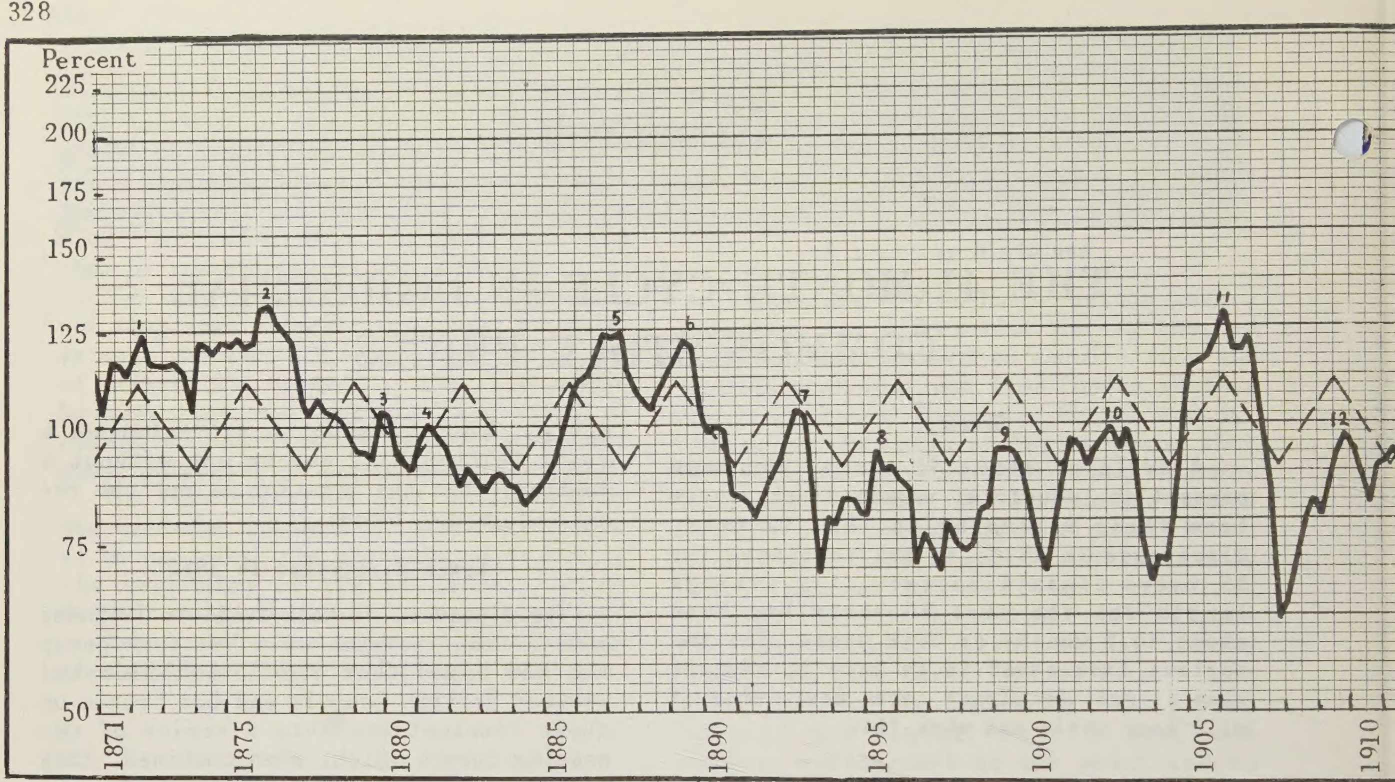


Fig. 2. Industrial common stock price index (Standard & Poor's Corporation 365 stocks) adjusted for trend and for a 9.2-year cycle. A perfectly regular 40.68-month cycle is represented by a broken zigzag line. This curve represents what the fluctuations of the stockmarket would have looked like

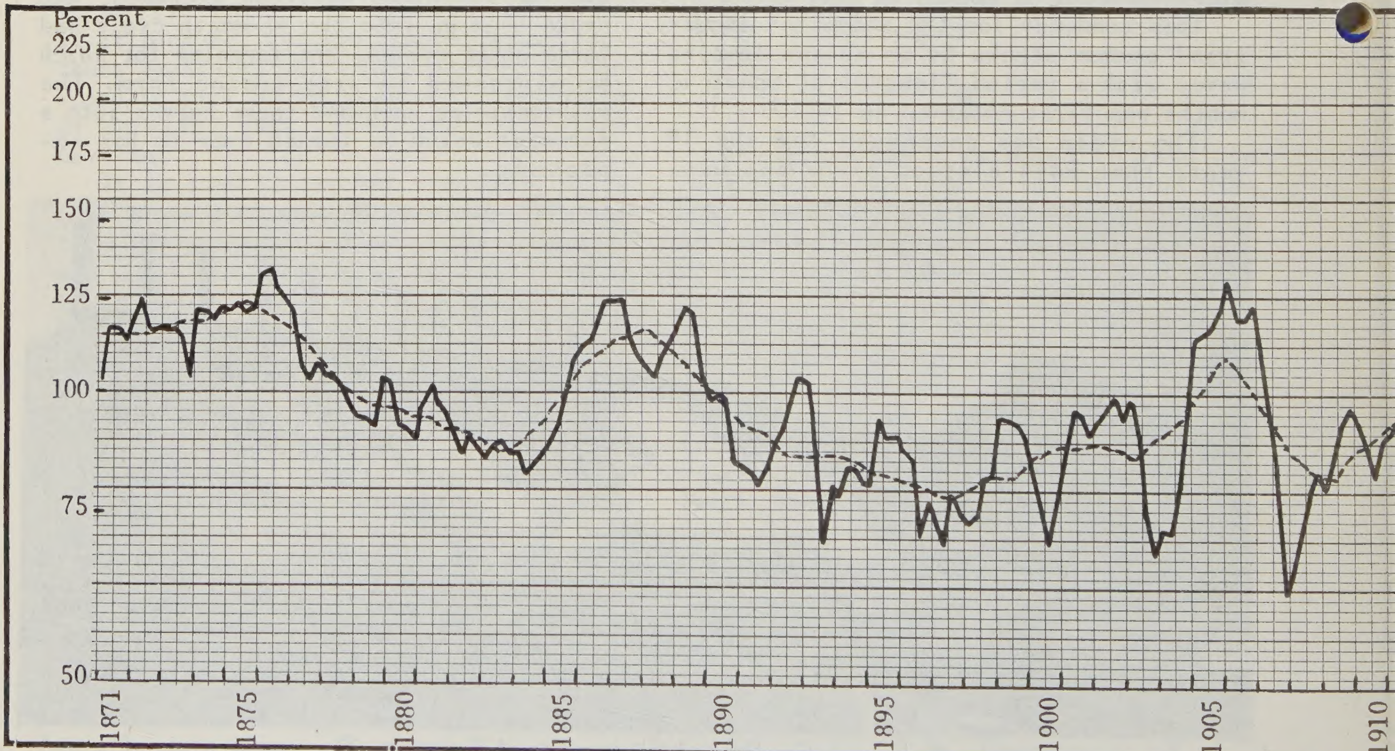
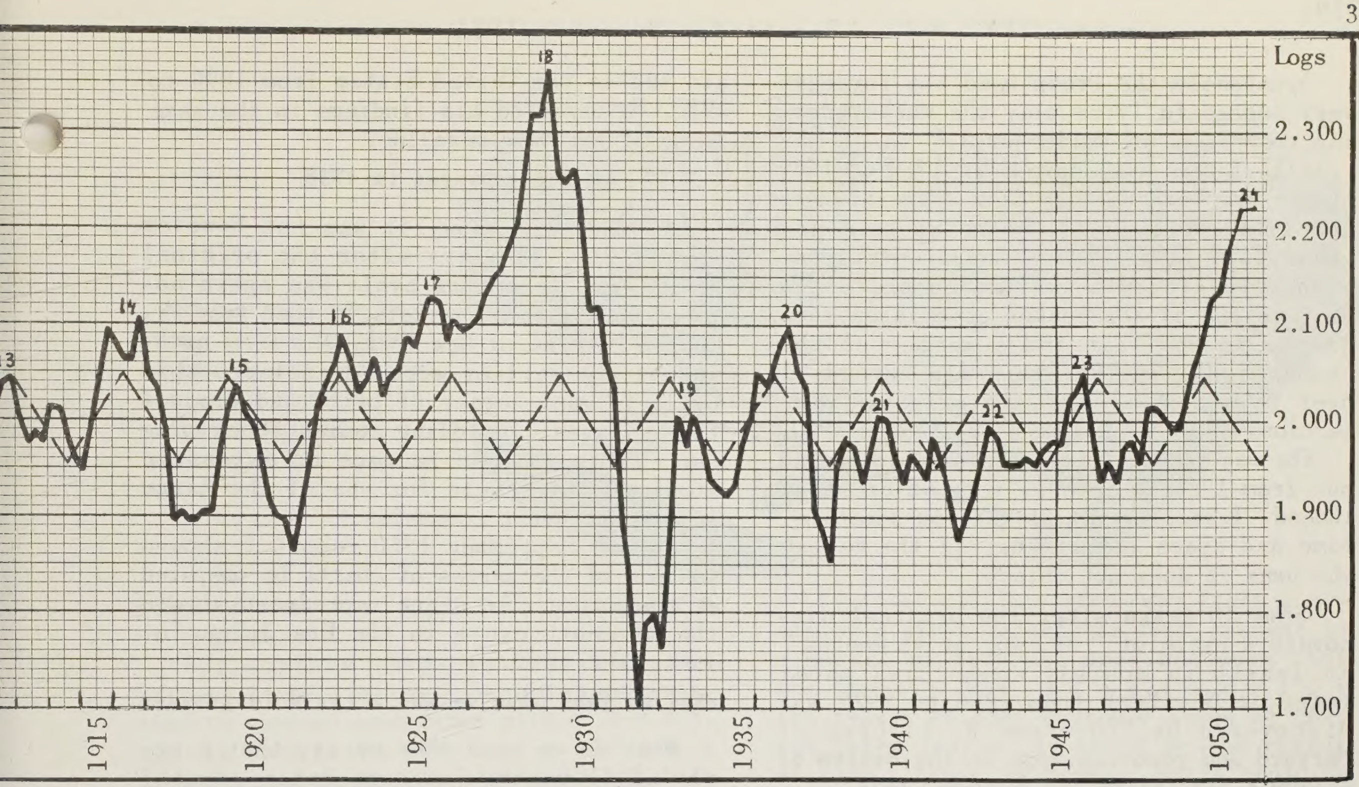
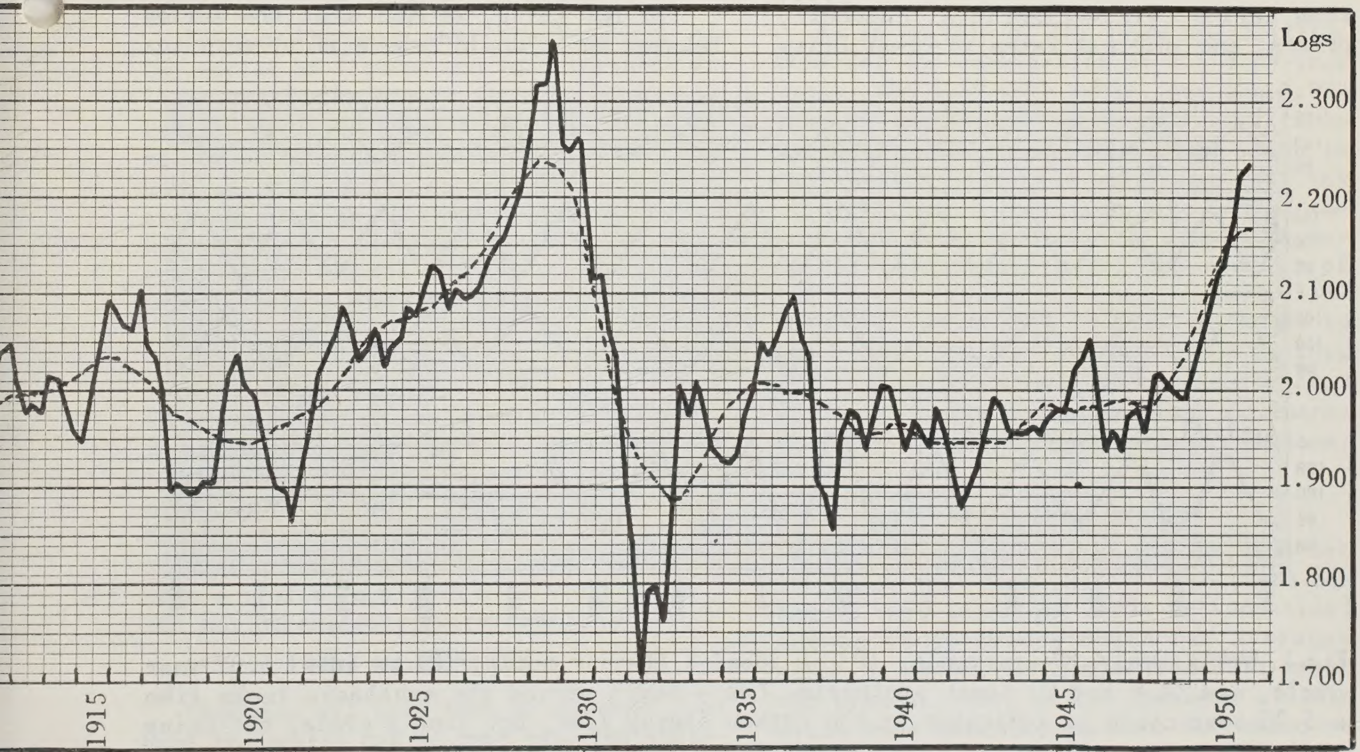


Fig. 3. The same curve shown in Fig. 2 above, together with its 13 quarter (39 month) moving average. A moving average trend of this length eliminates substantially all of a 41-month cycle,



If there had been no trend and if there had been no 9.2-year cycle. Values are expressed as percentages of trend. Note a rough tendency to conform to a cycle about 41 months in length. This chart, and Fig. 3, 4, and 5 to follow are drawn on ratio scale.



but goes up and down with the longer cycles. Such a trend is a very useful " base " from which to calculate departures. See Fig. 4 on page 332. The six end values are arbitrarily extrapolated.

Apparently the group used the forecast very successfully to play the market during the period of World War I.

All of this was learned in 1919 or 1920 by the New York partner of a large brokerage firm. He induced the group to share their formula with him (for a consideration). The formula was thereupon turned over to one of the Boston associates (now living in New York and a member of the Foundation). In 1947 this man turned it over to me, along with the original projections which he had made in 1919 or 1920.

The way in which the forecast had worked out from 1920 to date is very interesting indeed. I shall print it for you sometime, time and space permitting, if the member who owns it does not object.

Some 10 years after the original discovery a cycle of " 39, 40, or 41 months " in length in monthly commercial paper rates in New York from 1866 to 1922 was discovered by Professor W. L. Crum of Harvard and reported upon in the **Review of Economic Statistics** for January, 1923.

At the same time Professor Joseph Kitchin, also of Harvard, discovered a cycle, which he called 40 months, in six economic time series, viz;—clearings, commodity prices, and interest rates in Great Britain and in the United States from 1890 to 1922. He reported his findings in the same issue of the same magazine.

Rediscovered in 1935

As far as I know, it was not however until 1935, 23 years after the original discovery, that this cycle was again noticed in the stock market. In that year Mr. Chapin Hoskins of New York, who knew nothing of the earlier work, discovered this cycle in many series of price and production figures, including common stock prices. Early in 1938 he made an extensive study of this cycle for one of the large investment trust companies.

In our September 1950 report I showed you one of the series of charts he prepared at that time. The chart reproduced showed the 41-month cycle in the Dow Jones Industrials.

What we mean when we say a cycle is present

What do we mean when we say that a cycle of 41-months (or some other length) has been present in a series of figures over a period of time? We mean several things.

For one thing, we mean that the series behaves as it would behave if it were in-

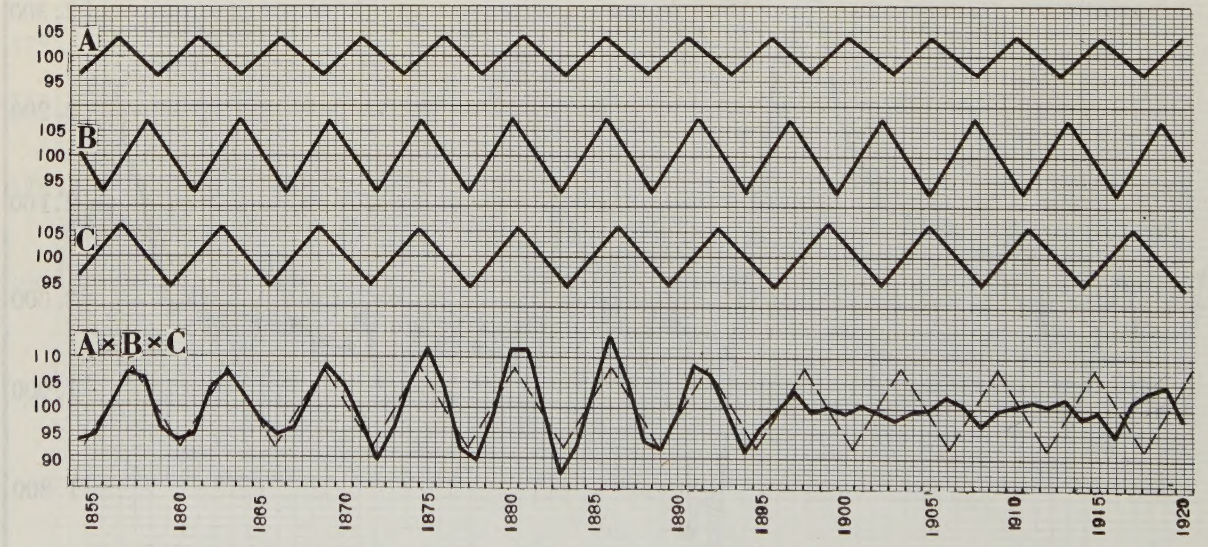
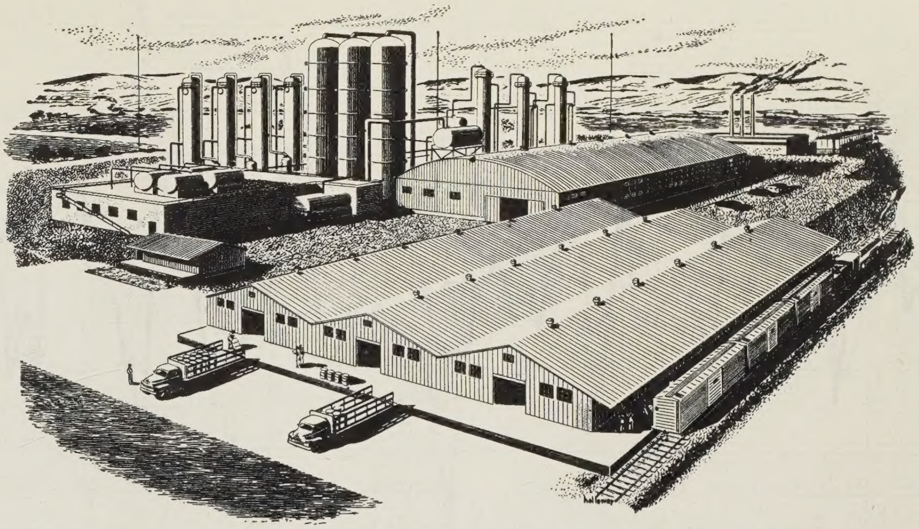


Fig.1. (A) An ideal 4.89-year cycle, (B) an ideal 5.50-year cycle, (C) an ideal 6.07-year cycle, and (A × B × C) their synthesis. For a short period the synthesis looks like a 5.75-year cycle as indicated by the broken zigzag line, but such a cycle, not being real, does not continue.



Industrial production, for as far back as figures are available, also shows a 41-month cycle.

fluenced over its length by a cyclic force of this period.

For another thing we mean that important highs, followed by important lows, tend to succeed each other with a beat, and at intervals which average this length. Note that the highs and lows do not succeed each other at the precise length of the cycle. When compared with perfectly regular timing some turning points are early and some are late.

We usually mean that the behavior of the series of figures can be described, at least partially, in terms of a perfectly regular cycle of the given length. Another way of putting it would be to say that if, upon a chart of the series of figures, we superimpose a succession of perfectly regular waves of the indicated length, the actual behavior will tend to correspond to this perfectly regular "ideal" cycle.

And finally we usually mean that at the various times of high of the ideal cycle (the series of crest points exactly the length of the cycle apart), the values will average more than the values at the various times of ideal low. That is, if one had bought at the times of ideal low and had sold at times of ideal high, one would have made a profit on the average, but not necessarily every time.

What we do not mean

Opposing all this that we do mean, you must be careful not to read into the statement things we do not mean.

First of all, the statement (that a cycle of a given length has been present in a series of figures) does not mean that the behavior was necessarily the result of some rhythmic force of this indicated length. It could be the result of such a force, of course; or it could be the result of random forces; or it could be the result of the interplay of two or more perfectly regular forces in combination.

As an example of the third possibility, consider the combination of the 4.89-year cycle, the 5.50-year cycle, and the 6.07-year cycle—tentatively determined to be present in the stock market and shown in combination with each other (without any other waves) in Fig. 4 on page 249 of the September 1951 report. This figure is reprinted above as Fig. 1. The product of the three waves shows a very nice 5 3/4-year cycle from 1854 to 1894, as shown by the 5 3/4-year zig-zag, but waves of this length were not among the components from which the composite was made up and therefore waves of this length do not continue.

41-month cycle present

With these qualifications in mind let me repeat that from 1871 to date there has been a very important cycle in industrial common stock prices which has averaged about 41 months in length from 1871 up to the present. Many of the upsweeps of this cycle have amounted to over 50% rise,—a number of the upswings exceeded 100%.

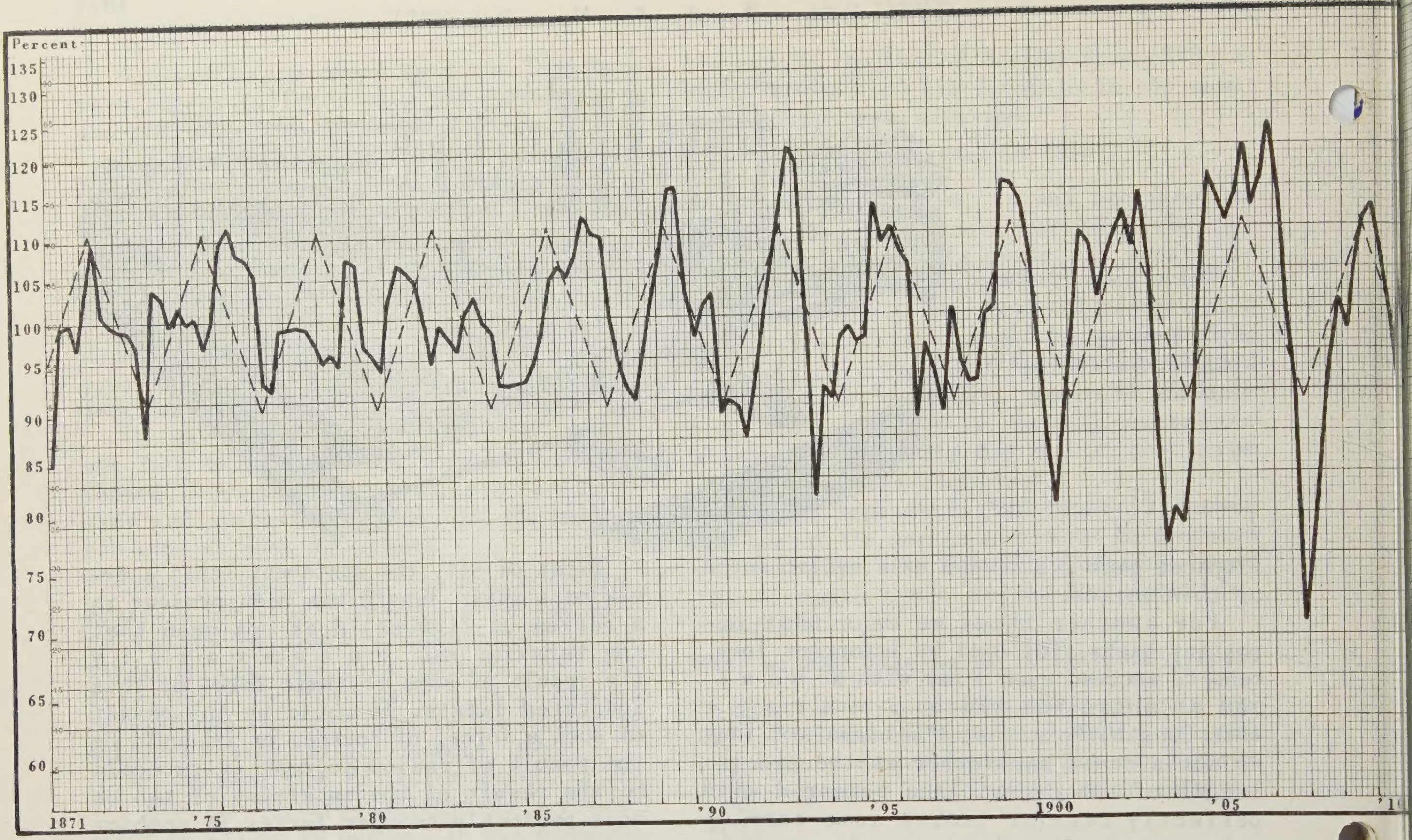


Fig. 4. Deviations of the curve in Fig. 3 on page 328 from its 13 quarter moving average. An ideal 40.68-month cycle has been added as a broken zigzag line. This curve is merely the difference between the curves in Fig. 3 and the trend. It represents what the curve in Fig. 3 would look like if the trend

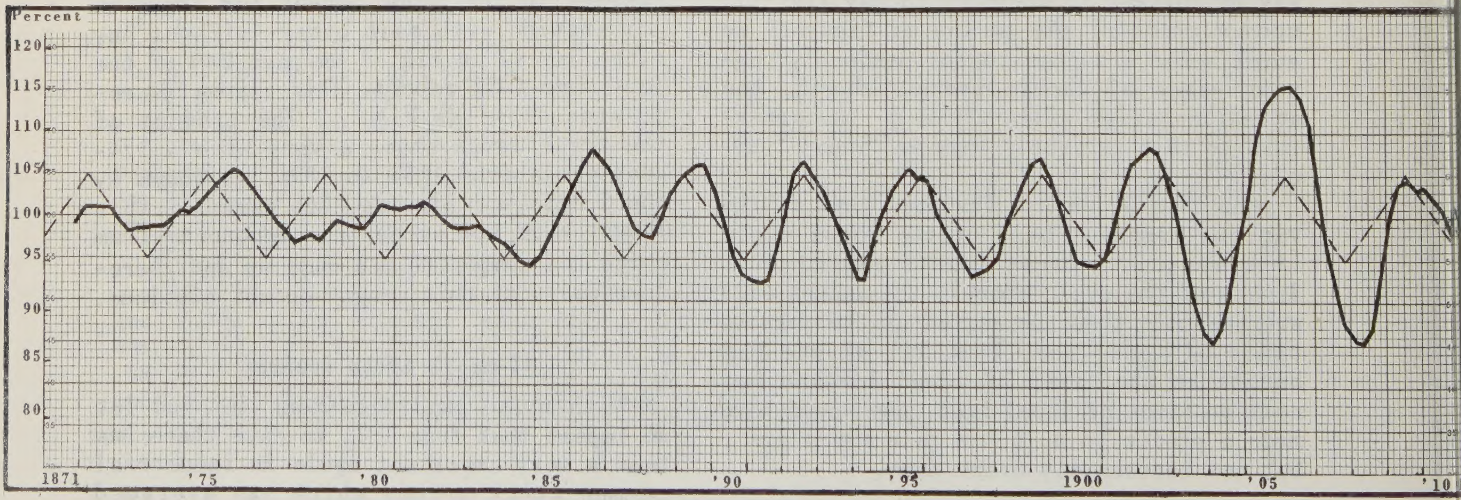
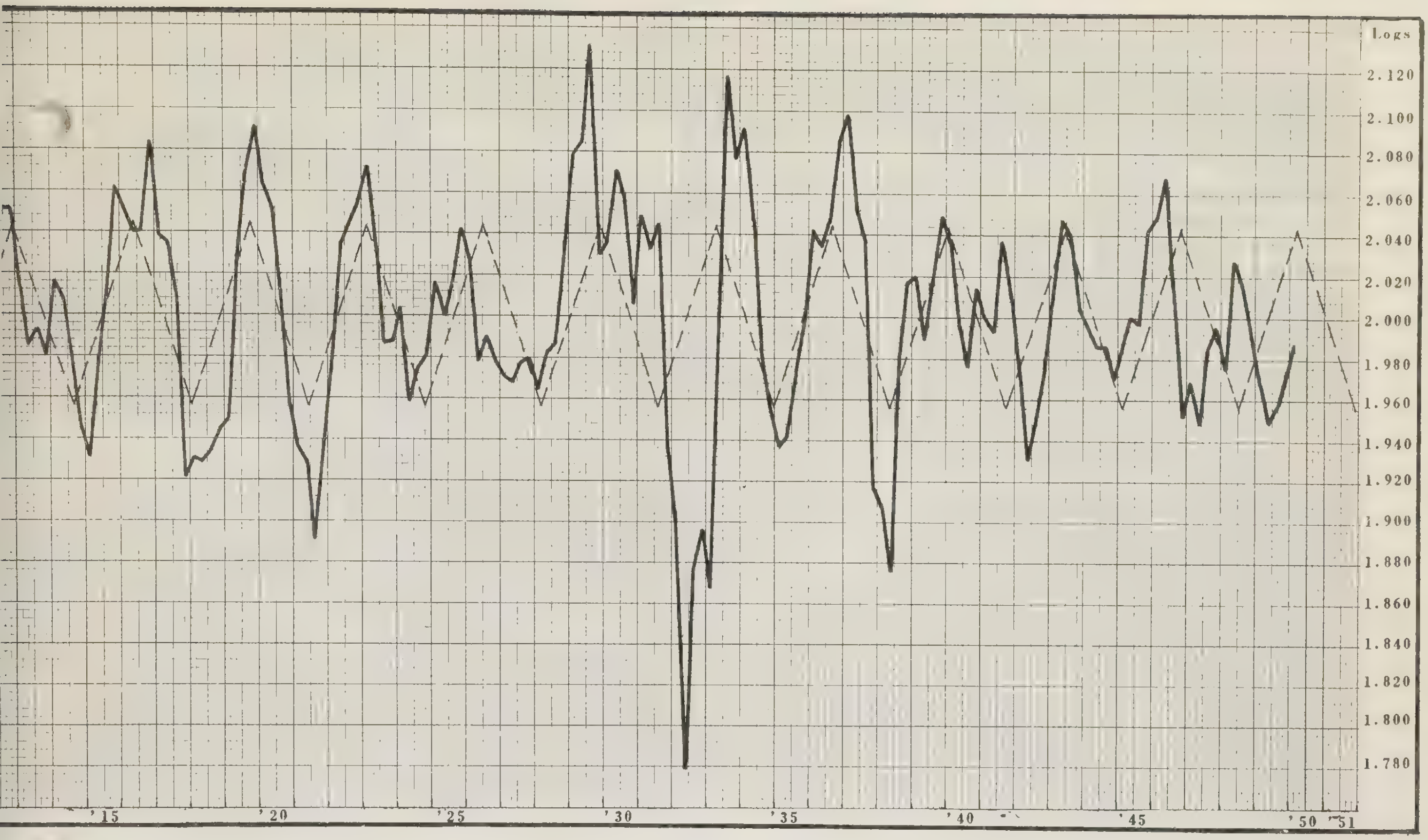
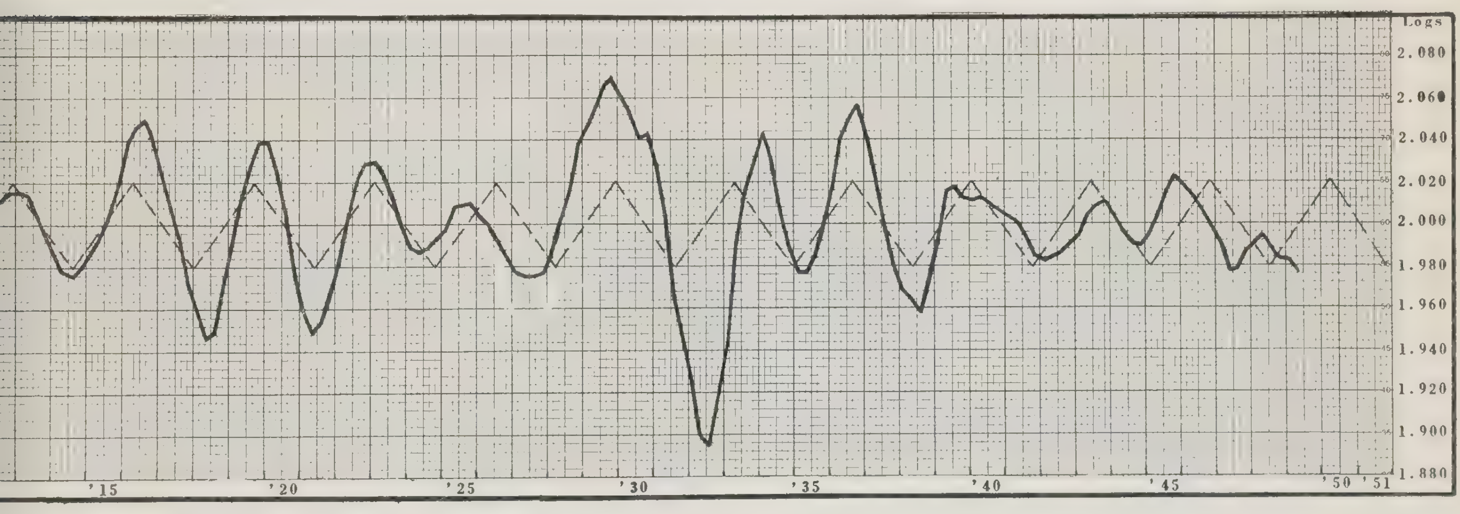


Fig. 5. The curve shown in Fig. 4 above smoothed by means of a 7 quarter moving average. Here again the broken zigzag line represents a perfectly regular 40.68-month wave. This smoothing operation eliminates the shorter cycles and accidental variations and enables you to see the 41-month cycle still more



were "pulled straight". It therefore eliminates the longer cycles or variations and enables you to see the 41-month cycle more clearly. This technique is very useful to help one to see the cycles of any given length freed as much as possible from the effect of longer waves.



clearly. Note that the last few 41-month waves have been of diminished strength. Note also that crests and troughs rarely come according to perfect timing. You need to take other cycles and non cyclic factors into account to know whether crests will come early or late, whether they will be important or not.

If you had known about this cycle in 1871 you could have made some very nice profits over the years but, unfortunately, from a knowledge of this 41-month tendency alone you would have not gotten full advantage of the situation because the various highs and lows have mostly been early or late—sometimes by very substantial amounts—and without knowing in advance which they were going to be, your profits would have been limited to the average gain, which is much less spectacular.

What of the future

Is this 41-month cycle in industrial common stocks "real?" Will it continue? What is its exact length, shape, and timing? Is the observed behavior the result of a single cyclic force of this length, or the interplay of two or more cyclic forces? If the latter what are these other cycles? What is their shape and amplitude, and when do they come? When can you expect the high of the important move, which began its current upsurge in June of 1949? Has it passed or is it still ahead, or is it just about now? When will you see the next low? Will the next low be deep or shallow? And how about the high to follow? I can think of no questions, the answers to which are of greater importance to all who are interested in market operations.

The facts

Let us start our study by examining the facts.

You will recall that in our April 1951 report I charted for you a series of industrial common stock prices from January 1871 forward. I also computed for you a straight line trend (of the logarithms of the data), and charted for you the deviations from trend—that is, the percentages by which the prices were above or below this trend line.

Then, in the June 1951 issue, I showed you the very important 9.2-year cycle present in these deviations.

The original data simplified

Now that you know about the 9.2-year cycle in stock market behavior you can simplify the deviations by adjusting them for the effect of the 9.2-year waves. This adjustment is made in the same way in which you would adjust a series of figures for seasonal variation. A chart of these deviations, on a quarterly basis, with this adjustment made, is shown in Fig. 2.

Fig. 2 thus represents the course of industrial common stock prices, quarter by quarter from 1871 through the first half of 1951, as it would have unfolded if there had been no trend and no 9.2-year cycle in these figures. In other words, the original curve has been simplified, so that other cycles which are present in these figures can now be seen more easily.

You may ask, why not simplify the curve further by removing the 19.4-year cycle described in our September 1951 report? This would be a good idea if the 19.4-year cycle had been discovered in industrial common stock prices, but this is not the case. This cycle was discovered in railroad stock prices. It may be present in industrial stock prices also, but this possibility has not yet been explored. The two series of figures behave differently and must not be confused. In this article we are discussing the industrial series.

A series of 41-month waves

If you look closely at Fig. 2 you will notice a series of waves coming on the average at about 41 months apart. To aid your eye I have added a series of zig-zags at uniform intervals slightly less than 41 months from each other, and have numbered the crests.

You will note that crests 1 and 2 were good but that crests 3 and 4 were almost entirely missing; crest 5 is present but very late. Crests 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 are good. Crests 17 and 18 are early. Crests 19 and 20 are good. Crests 20 and 21 were weak and early, and crest 22 very early. Crest 23, the present one, is late.

In summary, if we assume a length just short of 41 months, out of the 23 crests, we have 14 good, 7 considerably distorted, and 2 missing altogether.

It is obvious that in addition to the 41-month cycle there are other fluctuations present also. These can be minimized as follows: To minimize the longer fluctuations, run a new trend line through the values, as shown by the broken line in Fig. 3, and compute the deviations of the curve from the new trend. If you do this you will get the values plotted (with exaggerated vertical scale) in Fig. 4. (For details, see the Technical Section of this report.) As the longer cycles have been minimized you can see the 41-month waves more clearly. Here again, to aid your eye I have added a zig-zag just under 41 months in length.

To smooth out the short term fluctuations, you use a short term moving average. Such a moving average has been computed and is shown in Fig. 5. (For a discussion of the use of the moving average in cycle analysis, see Technical Bulletin No. 4 issued by the Foundation.)

Fig. 5 gives you nearly as good a visual presentation of this cycle in this series of figures, wave by wave, as you can get.

Other observations

If you study Fig. 5 two things become at once apparent.

First, a cycle a shade under 41 months (40.7 months or 3.39 years) fits the behavior pretty well over the entire span of time.

Second, there is very definite evidence of other cycles. These must be identified and isolated before we can hope to have even a hint as to whether or not any given future high or low will be early or late, important or unimportant.

Third, it is clear that the 41-month cycle is much stronger and more regular in the middle of the 80-year span under consideration than at the ends. This fact could mean that the so-called 41-month cycle is really a combination of two cycles of very nearly the same length, which were more or less together for many years, which have latterly been pulling apart, and which presently will start pulling together again.

(Note, however, that if this is the situation, the waves from here on will be half a cycle out of step with the waves as they have shown themselves in the past. See the article in the December 1950 rediscussing the work of Mr. W. C. Yeatman in connection with compound cycles).

A promise

The true facts in connection with this whole subject are of the utmost importance. I shall, therefore, try to clear up this matter for you at the earliest possible moment, for it will be of more help than anything else I know about in connection with the probabilities of future market behavior.

Bank debits have also shown a 41-month cycle.

NEED TO KNOW CAUSE OF 10-YEAR GRASSHOPPER CYCLE

IN an article about a new insectiside useful for the control of grasshoppers, Professor J. H. Pepper and J. P. Corkins of the Montana Experiment Station writing in the **Country Gentleman** for June 1951, conclude by saying:—

"However, simply killing grasshoppers when they have broken loose and are threatening to destroy our crops and pastures solves only part of the problem. The next step should lead to prevention of periodic infestations.

"Past history shows that explosive outbreaks occur every ten years, more or less. These outbreaks, which spread destruction, make news headlines and cost farmers and the public millions of dollars to battle, are believed to develop from build-ups in certain local areas. Such build-ups may develop for several years and then flare into a widespread infestation. There is still much to be learned about the outbreak process, by which whole areas of the West at times are confronted with a devastating 'hopper 'invasion.' It becomes more important than ever to search out and gain a clear understanding of causes of outbreaks, because with the advent of effective and economical control methods, we might go far in eliminating the constant threat to the prosperity and productivity of many millions of acres of Western lands."

Explosive outbreak occur every ten years, more or less.

In the above quotation Drs. Pepper and Corkins hit the nail on the head. We need to know causes.

Here is where a study of cycles comes in. If we have a 10-year cycle of 'hopper outbreaks we must look to see what environmental factors also have 10-year cycles. If we can find something which does fluctuate in this way we have a clue as to what may cause the 'hopper cycle.

If there is a 10-year cycle in temperature, or humidity, or barometer pressure, or atmospheric electricity or ozone concentration or any other natural phenomena as well as in 'hopper outbreaks, the entomologist can go on from there to discover, perhaps by laboratory experiment, if there are any possible direct or indirect relationships.

The mere fact of identity of cycle length does not prove interrelationship. (As you doubtless know, we have a four-year cycle of mouse abundance as well as a four-year cycle of presidential elections.) It merely suggests interrelationship.

Moreover, if there is the slightest difference in length between the cycle of the 'hoppers and the cycle of the other phenomena there can be no connection, for these differences are cumulative and the cycles which are in step today would be out of step, and hence unrelated, say 100 years from now.

A second value to come from cycle study is the forecasting value. If we can know the cycles involved we can use this knowledge to predict outbreaks, insofar as the cycles control the situation. Thus we can get directly at the end result sought, even if we do not know cause.

I have done some work on cycles in 'hopper abundance upon which I shall report in an early issue.

寒暖の歴史

THE 700-YEAR CYCLE IN JAPANESE CLIMATE

Summary

A cycle of about 700 years in length has been discovered in Japanese climate. It seems to have been present from about 700 B. C. to date. The present century falls in a cold phase. If the cycle continues, Japanese climate should get gradually warmer for the next 350 years, and then start to get colder again.

IT was a great pleasure to receive recently from Hideo Nishioka, a professor at Keio University in Tokyo, a copy of his book **History of Cold and Warmth—The Theory of a 700-Year Cycle in Japanese Weather**. This book is written in Japanese and was published by Kogahuska in Japan in 1949.

I do not read Japanese, but through the great kindness of Mr. Yoheo Arai, a neighbor of mine in Riverside, Connecticut, I am able to give you a translation of the table of contents of Professor Nishioka's book and also to give you an explanation of some of the charts contained in it.

From this table of contents and from the charts, you can get a fairly good idea of the contents of the work.

If the subject matter is of especial interest to you, and if you read Japanese, I will be glad to lend you the book so that you can acquaint yourself more fully with Professor Nishioka's research.

The table of contents is as follows:

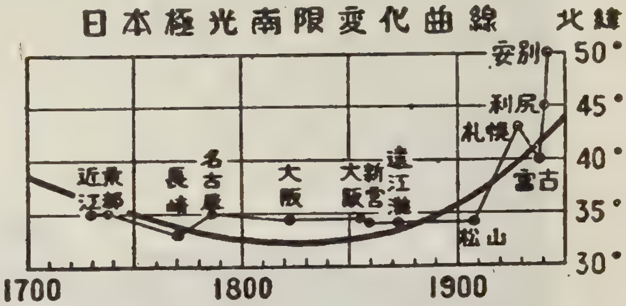
I. Preface
II. The theory of a 700-year cycle as evidenced by annual tree rings
    1. The relationship of weather and tree rings
    2. The cycles of changes in weather
    3. The death by freezing of the army of Nitta Yoshisada and tree rings
III. The southern progress of sea lions
    1. The relationship of warm weather and sea water
    2. Sea lion islands
IV. The non-freezing of Lake Suwa in winter
    1. The phenomenon of the god's passage on Lake Suwa
    2. The period on non-freezing in water on Lake Suwa
V. Changes in the distribution area of horse chestnut (tochi-no-ki)
    1. The existence of leaf bottom earthen ware
    2. Kinds of leaves on leaf bottom earthen ware
    3. Thoughts in the botanical aspects of the horse chestnut
    4. The horse chestnut appearing in prehistorical remains

  5. The horse chestnut as it appears in literature
  6. The horse chestnut as remaining in place names
- VI. The increase and decrease of special species of shells in shell pits
  1. The Kanto district and the study of shell pits
  2. The increase and decrease and the evidence of warmth and cold in the fish world

Soldier in Korea.

Three hundred and fifty years from now winters in Korea and Japan will be warmer, if the 700-year cycle continues.

附圖第一二 日本極光南限變化曲線



The most southerly latitudes in which the aurora borealis was seen.

- VII. Natives wearing snow glasses
  1. Natives of the stone age
  2. Development of the theory of ray protecting apparatus worn by natives
  3. Development of opposition to the above theory
  4. Revival of the above theory
- VIII. Blooming period of the cherry and cherry blossom viewing
  1. Blooming period of the cherry in recent years
  2. Blooming period of the cherry as appears in history
- IX. Study of the aurora
  1. The aurora in foreign countries
  2. The aurora in Japan and Korea
  3. Cycles of the aurora
- X. Conclusion

  Supplementary theory

  The question of the limitation of the extent of the stone age in Japan
  1. The question of the existence of the stone age in Japan
  2. Man's theories on the limitation of the extent of the stone age in Japan

This book, like all Japanese books, starts in what we would call the back and goes forward to what we would call the front. The characters are written in columns instead of in lines. The right hand column is read first, from top to bottom, and so on progressively across the page to the left.

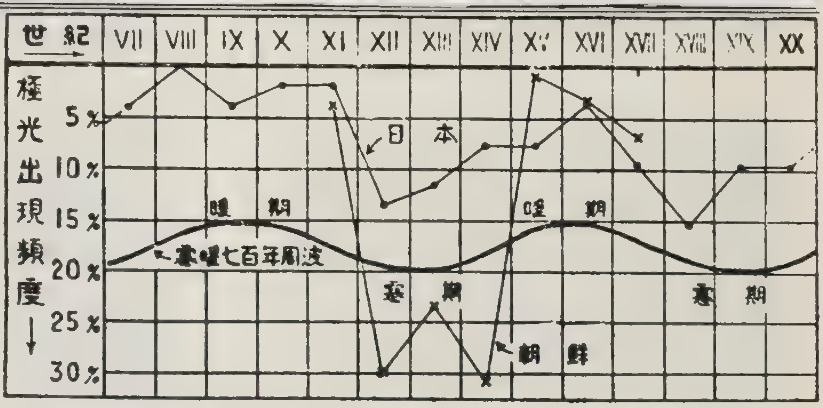
The book contains a number of charts which I think you will find of interest. They are reproduced below.

The aurora borealis, or northern lights. The aurora in Japan and in Korea evidences a 700-year cycle, based upon records of the number of times it was observed during previous centuries.

The number of times over the centuries the aurora borealis was seen.

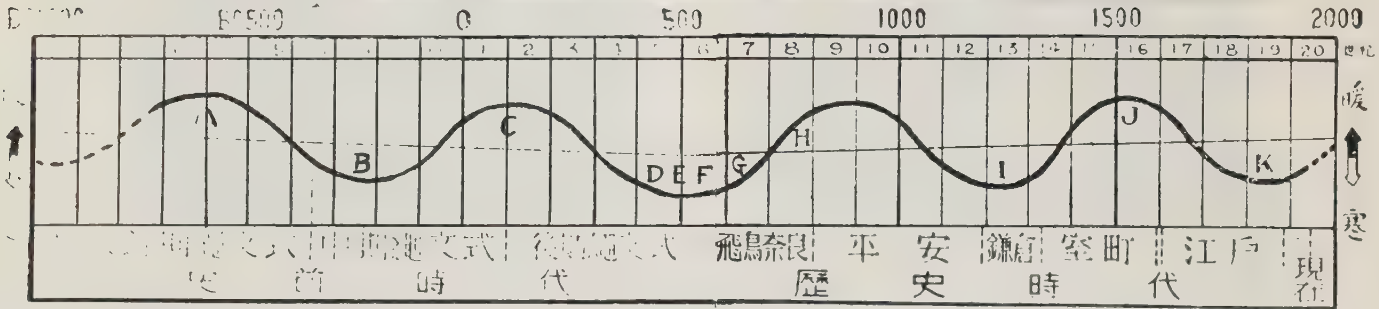
The zigzag from the 7th to the 19th centuries represents the number of times the aurora was seen in Japan, century by century, expressed as a percentage of the total number observed.

The zigzag line from the 11th to the 17th centuries represents the same information for Korea.

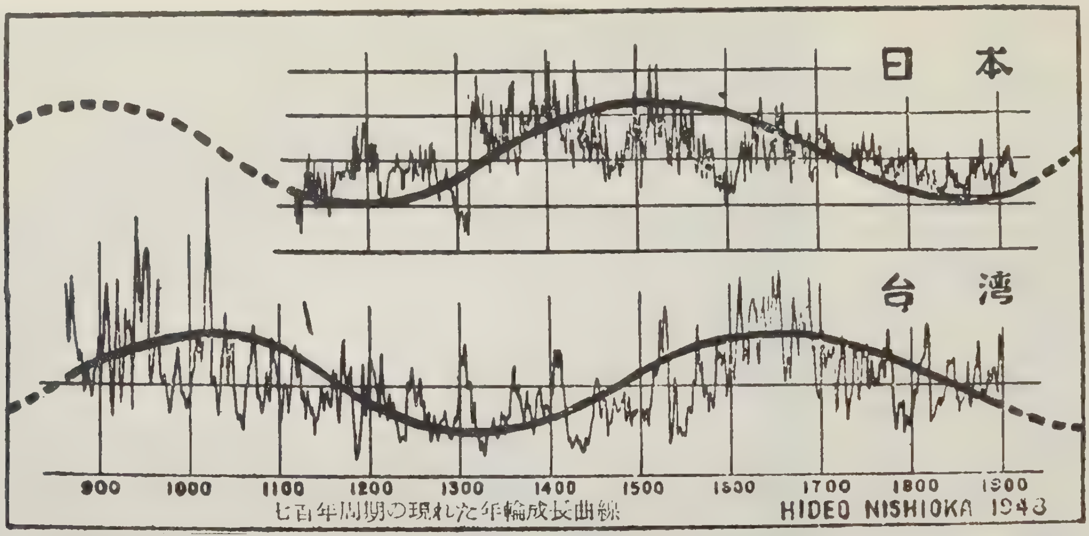


極光世紀別出現頻度曲線 西岡原図 1948

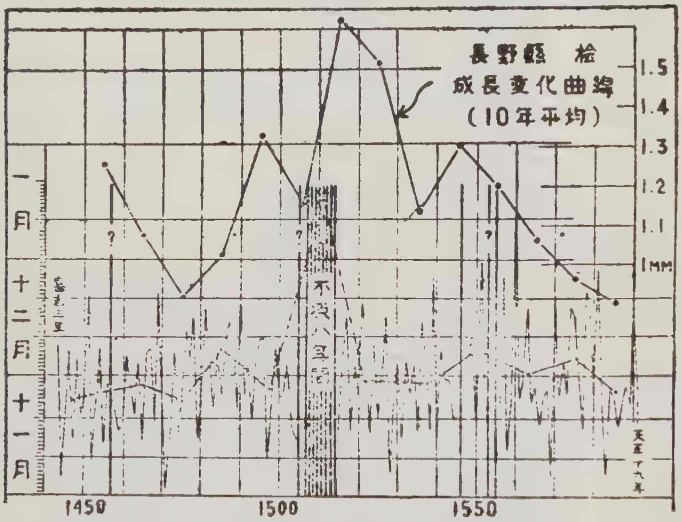
The smooth underlying curve represents the estimated temperature over the same period, the 9th and the 16th centuries being warm; the 13th and 19th centuries being cold.



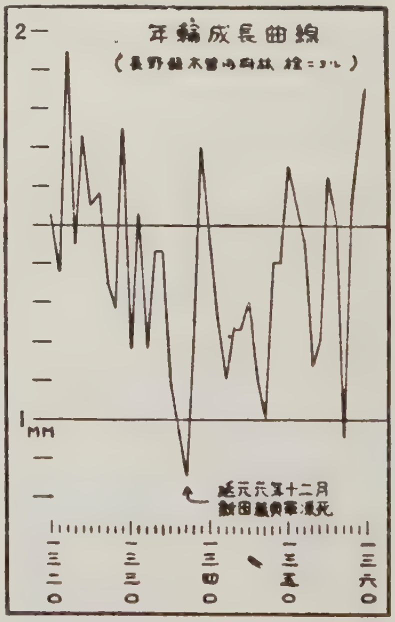
The 700-year cycle in Japanese climate from 700 B. C. to the present time. The alternation of heat and cold in prehistoric times is deduced from the nature of sea shells found. In later years the climate is deduced from the thickness and thinness of tree rings, and in other ways as is explained in the text.



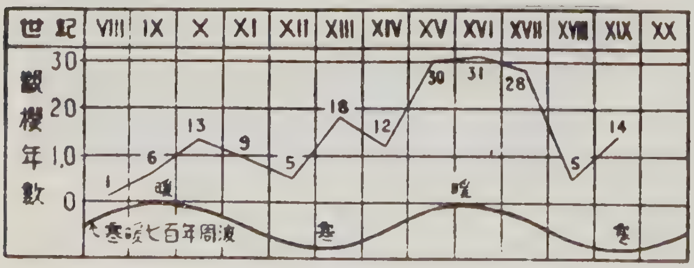
Tree ring growth by years, showing 700-year cycle. Upper curve, tree ring growth in Japan by years c. 1120 to c. 1920. Lower curve, tree ring growth in Formosa by years c. 860 to c. 1900. Points above the axis indicate excess growth. Points below the axis indicate a deficiency of growth.



The dates on which ice froze on Lake Suwa. Upper curve shows average tree ring growth for the decade indicated. The vertical lines from 1507 to 1514 inclusive represent 8 years when the lake did not freeze at all.



Growth of tree rings during period when Nitta Yoshisada's Army was frozen.



史料に現れた観櫻世紀別頻度 西岡 康圖

The number of volumes about viewing cherry blossoms. Upper curve, number of volumes in each century as indicated. Lower curve, estimated temperature. Warm periods are shown in the 9th and 16th centuries; cold periods in the 13th and 19th centuries.

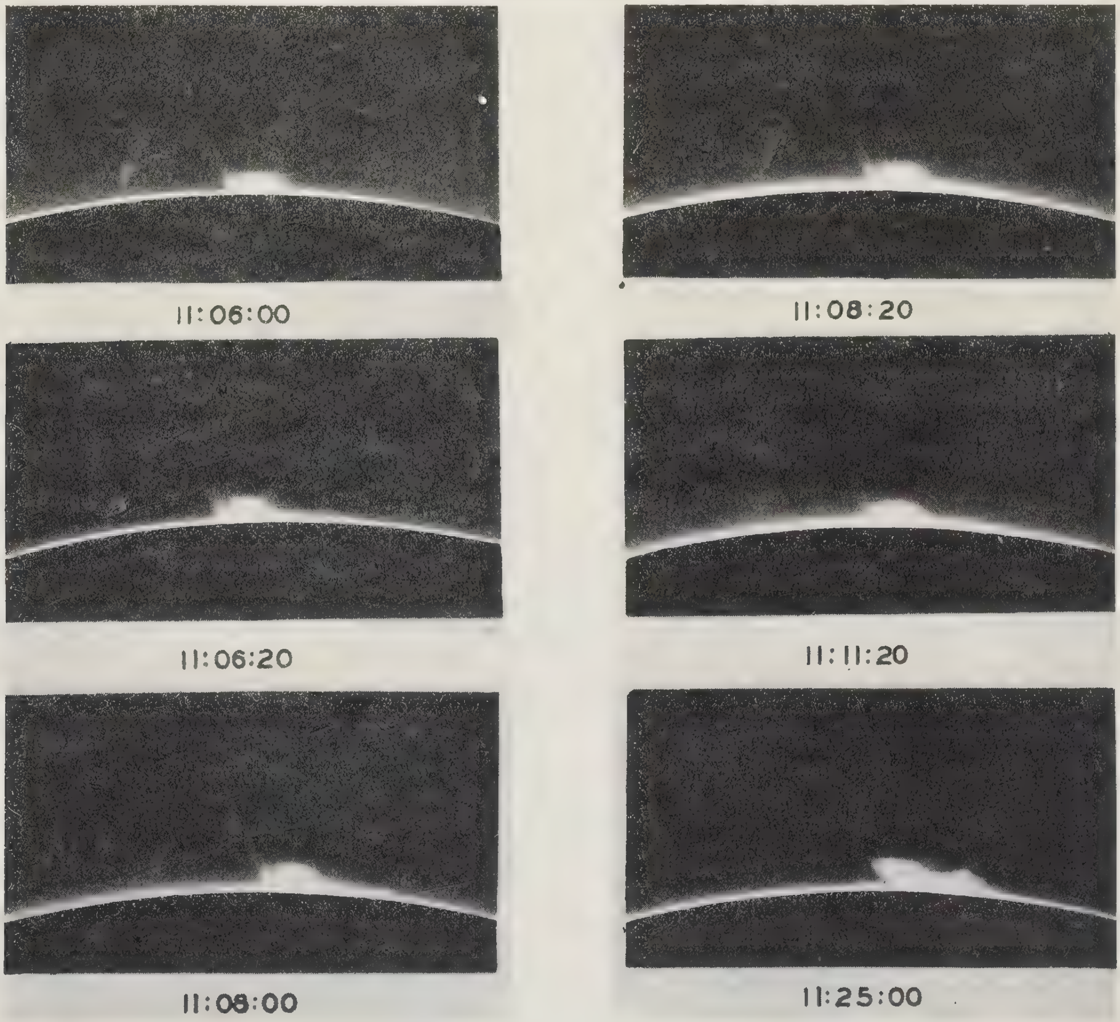
THE 37-YEAR CYCLE – CONTINUED

2. THE 37-YEAR CYCLE IN SUNSPOTS WITH ALTERNATE CYCLES REVERSED (SINCE 1749)

Summary

A cycle in the general neighborhood of 37-years in length has been present in sunspots with alternate cycles reversed throughout the period for which sunspot numbers are available (200 years). So far it has not been possible to determine the exact length of this cycle with assurance.

Such evidence as we have for a 37-year cycle in sunspot numbers comes from the work of Gerould T. Lane of Rochester, New York. Mr. Lane came upon a cycle of this general order of magnitude when studying sunspot numbers with alternate cycles reversed to see if these figures contained a 54-year cycle. The 54-



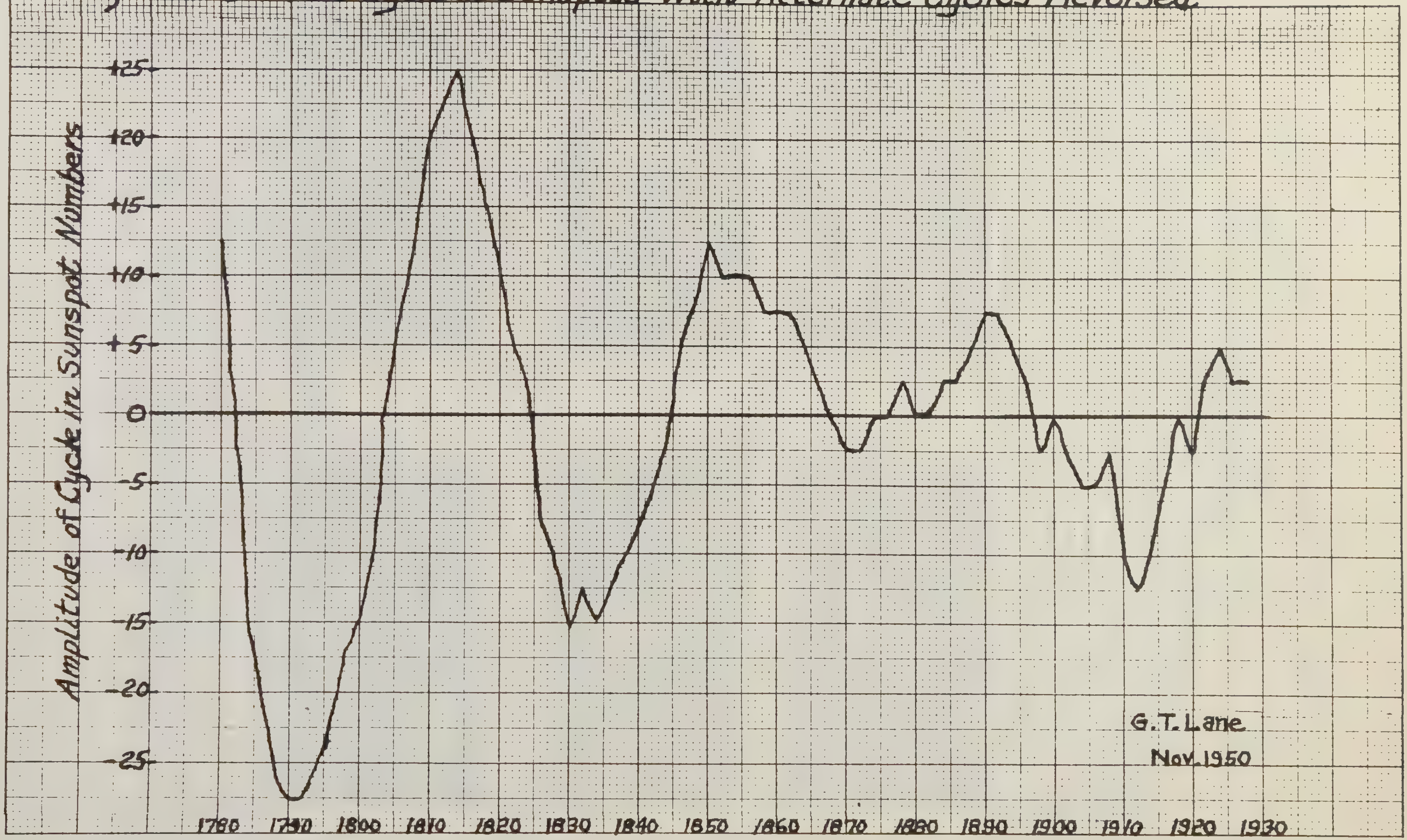
11:06:00 11:08:20

11:06:20 11:11:20

11:08:00 11:25:00

A skyrocket prominence of February 6, 1941, as photographed with the coronagraph at Climax, Colorado, over a period of 19 minutes. Note the rapid change in the jet on the left compared to the relatively quiescent one on the right. The earth would be about as big as a capital O. Prominences are often associated with sunspots. From **The Telescope** for March-April, 1941.

Fig. 1. 37 Year Cycle in Sunspots with Alternate Cycles Reversed.



G.T. Lane
Nov. 1950

year cycle was not found; a shorter cycle showed up instead.

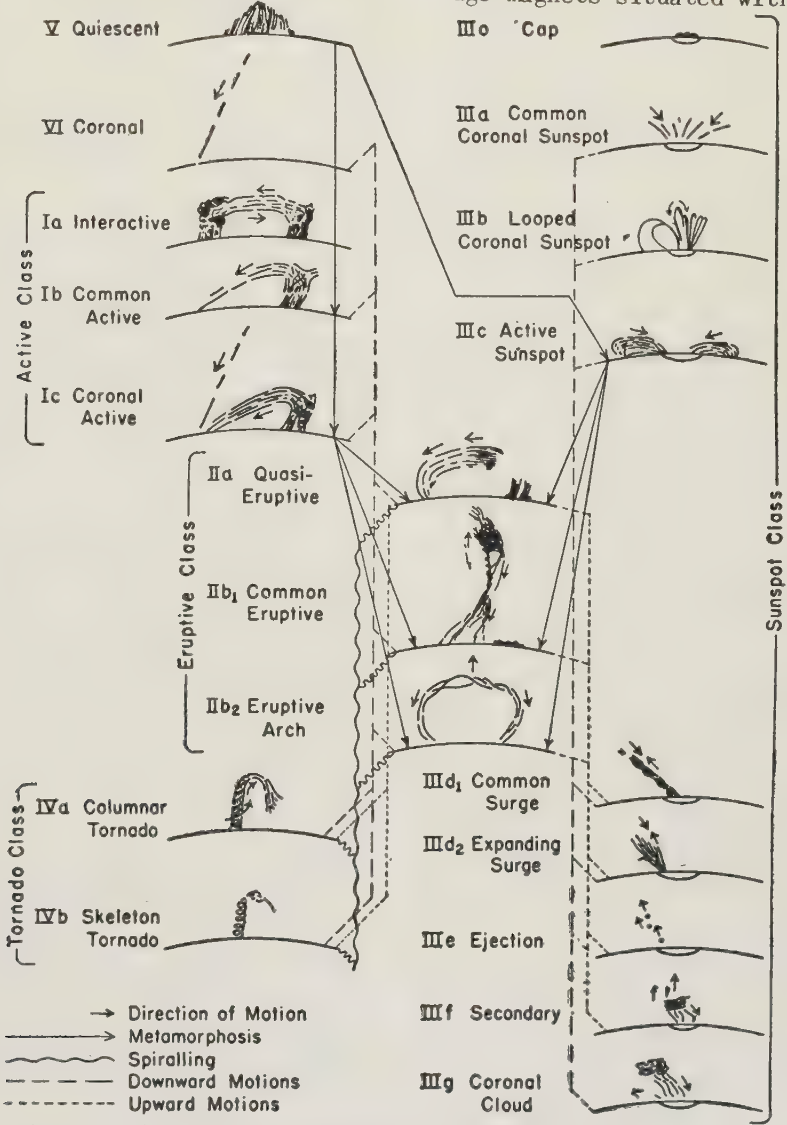
Sunspots with Alternate Cycles Reversed

For the benefit of new members I should explain the term " sunspot numbers with alternate cycles reversed. " Let me quote from our June 1950 report.

" To start at the very beginning, sunspots are areas on the surface of the sun which are cooler than the surrounding surface and therefore appear dark. As yet no one knows what causes them.

" The number of spots increase and decrease, as you know, in a rhythm which averages a little over 11 years from crest to crest.

" Also, as you doubtless know, sunspots evidence magnetism. This fact is revealed by the spectroscope. The spots act as if they were north poles or south poles of huge magnets situated within the sun.



Types of prominences illustrated by drawings from photographs. While most types are found isolated as shown, several of the sunspot class are frequently found together. In class IIIf the part of the prominence classified is indicated by the letter f. From **Astronomy**, by Skilling and Richardson, copyright 1947, published by Henry Holt & Co, New York, New York.

"Again, sunspots usually come in pairs, a north or 'positive' spot associated with a south or 'negative' spot.

"Finally, in one 11-year cycle in the northern hemisphere of the sun, 'negative' or south-seeking spots will tend to lead, in the next 11-year cycle in the same hemisphere, 'positive' or north-seeking spots will tend to lead, then the pattern repeats and for the next cycle 'negative' or south-seeking spots lead again, and so on. (In the southern hemisphere the situation is reversed.)

"About 15 years ago, C. N. Anderson of the Bell Telephone Laboratories said to himself, 'If one cycle represents an increase in "positiveness," and the next cycle an increase of "negativeness," why not use the zero line as an axis and represent the "negative" cycle below the line?' No sooner said than done . . . ."

A 22-Year Cycle

Naturally if you start with an 11-year cycle and turn every other cycle upside down you would expect to obtain a 22-year cycle, and this is exactly what you get, only, as the 11-year cycle is not exactly regular, the 22-year cycle is not exactly regular either.

When you make a careful study of the irregularities you find that they too come at regular intervals. For example, if you determine the exact amplitude and shape of the 22-year cycle and adjust for it just as you would adjust a series of figures for a seasonal pattern, you find that the remainder shows a very clear and very important cycle about 18 years long.

Similarly, if you search further in these figures of sunspot numbers with alternate cycles reversed you find other cycles of importance in terrestrial affairs.

Cycle Analysis like Chemical Analysis

The process of searching for cycles in series of figures when there are several cycles present at the same time is similar to chemical analysis. In both instances you manipulate that which you want to investigate in such a way as to minimize the obscuring elements. For example, if you have sugar disolved in water you can not see the sugar, but if you evaporate the water you will get the sugar as a remainder, if it is there. Or, if you have a mixture of blueing water and charcoal you can filter out the charcoal so that you can see the tinted water.

Mr. Lane's Work

Similarly, by filtering processes which are described in the technical section of this issue, Mr. Lane obtained the curve shown herewith as Fig. 1. The methods used by Mr. Lane lose some values at each end of the series, so we have a chart only from 1780 to 1928.

Study of Fig. 1 shows us that there are indeed cycles of this general order of magnitude in these figures, but the series is not long enough to enable us to know for sure what the length is, or if the cycles are "real" or accidental.

The 37-Year Cycle

Taking the crests alone, from the first crest in 1814 forward a length of 37 or 37 1/2 years fits very well. On the other hand, if we time the troughs we find that a length of about 41 years fits the behavior better. The series is just simply not long enough to tell us what we want to know with complete accuracy.

I am sure that Mr. Lane would agree that in view of the shortness of this series, the most we can say at the present time is that during the past 200 years there has been an important cycle or combination of cycles in sunspot numbers with alternate cycles reversed with a period in the general neighborhood of 37 or 37½ years, but which could be as short as 36 years on the one hand or as long as 41 years or so on the other. Further work may enable us to definitize the length.

Technical

TECHNICAL SUPPLEMENT TO THE ARTICLE ON PAGES 327 TO 335 REGARDING THE 41-MONTH CYCLE IN INDUSTRIAL COMMON STOCK PRICES

The data used were quarterly averages of the Standard and Poor's Corporation Industrial Monthly Averages (365 stocks), carried back through 1871 by the Cowles Commission for Research in Economics, adjusted for a straight line trend fitted to the logs of the annual data by means of least squares.

The monthly data, in the form of percentage deviations, in logs, from January of 1871 through December of 1950 will be found on pages 146 and 147 of our April 1951 report.

Values for the first nine months of 1951 are as follows: January 2.136, February 2.151, March 2.138, April 2.144, May 2.147, June 2.141, July 2.142, August 2.164, and September 2.178.

The quarterly values of the deviations were first adjusted for the effect of the average 9.2-year wave described in our June 1951 report on pages 204-207.

As indicated in that article, crests of the ideal 9.2-year wave fall in the middle of 1891 and 9.2 years either way from that point. Troughs fall midway between the crests. The average amplitude of the ideal wave is 123.3% of trend at time of crest and 81.1% of trend at time of trough. The shape of the wave was assumed to be linear.

The zigzag diagrammed on Fig. 2 on page 328 represents a 40.68-month wave. Crests fall on the 3rd quarter of 1892 and 40.68 months (13.56 quarters) backward and forward from that date.

The broken line in Fig. 3 on page 328 is a 13-quarter moving average of the values shown in that chart and in Fig. 2. The six values lost at either end by the computation of the moving average are filled in by an arbitrary extrapolation.

It should be noted that the values of the actual curve in Fig. 2 and 3 are logarithms and that the moving average is, therefore, a geometric moving average of the actual deviations. The scale at the right shows the logarithmic values. The scale at the left represents antilogs or percentages.

Fig. 4 on page 332 represents the differences between the curve and the 13-quarter moving average, again expressed as percentages.

This manipulation reduces the amplitude of the longer waves, and enables waves about 40 months in length to stand out more clearly. For example, in Fig. 4 cycles of 15 quarters (45 months) are reduced by 13⅓%, cycles of 20 quarters (60 months) are reduced by 35 %.

Fig. 5 on page 332 represents the values in Fig. 4 smoothed by a 7-quarter moving average. In this curve the three terminal values are not estimated. The length of 40.68 months (13.56 quarters) was accepted as the most probable length of this wave on the average over the entire period because the crest and trough of the second half of a 13.5-quarter periodic table slipped 2/3 of a position to the right.

As each half of the periodic table summarizes 11 cycles we obtained a length .67 ÷ 11 more than 13.5, or 13.56 quarters. For those who wish to duplicate the work, it should be mentioned that in averaging the various columns of the periodic table we used the average median (based on the five middle values) instead of the mean.

The length of 13.56 quarters or 40.68 months will be exactly correct only in the event that 11 cycles happens to be the synodic period of this cycle and the more important concurrent cycles, but it is close enough to the truth to serve for a first approximation, if we are dealing with a single, as distinct from a compound, cycle.

TECHNIQUES USED TO ISOLATE THE 37-YEAR CYCLE IN SUNSPOT NUMBERS

In the Report Section of this issue I told you of a 37-year rhythm found by G. T. Lane of Rochester in sunspot numbers with alternate cycles reversed. This rhythm appeared after Mr. Lane had " filtered " the raw figures in such a way as to minimize the effect of any short waves that might be present.

You will find the raw figures for sunspot numbers, alternate cycles reversed, on page 11 of the June 1950 report, and discussion of the concept of reversed cycles on page 10 of the same issue. This discussion is repeated on page 343 of the present report. You will find something about the 22 1/5-year rhythm and the 18-year rhythm in these figures in the June 1950 and September 1950 reports respectively.

In these same reports, and in the November 1950 report, you will find accounts of the techniques used by Mr. Lane to filter out rhythms of one wave length so that rhythms of other lengths can be seen more clearly.

The methods used for the determination of the 37-year rhythm in sunspot numbers, in Mr. Lane's own words, are as follows:

" In each sunspot cycle, many of the spots are seen in pairs and it is possible that where a spot seems to be single that the other part of the pair is below the surface. It has been suggested that a pair of spots could be considered as the two ends of a revolving piece of hose, for each spot of a pair is apparently whirling in the opposite direction from the other, for the magnetic charge on one is positive and on the other negative.

" In the northern hemisphere of the sun the leading spots of all pairs have the same charge during a given sunspot cycle, and during the same cycle the leading spots in the southern hemisphere have opposite charges from those in the northern hemisphere.

" When a sunspot cycle fades out and a new cycle starts the charges on all the leading spots are reversed. For that reason many people like to think of a cycle about 22 years in length rather than an 11 year cycle. By considering one 11-year cycle as positive and the next as negative it is very easy to construct a 22-year cycle from the yearly figures. In fact the sunspot cycle with alternate 11-year cycles reversed is much more uniform than the 11-year cycle.

" The finding of a 37 year cycle in the values of this double sunspot cycle was a distinct surprise for, at the time, I was using methods that would give a maximum amplification for a cycle about 54 years in length, a well known economic cycle.

" The methods used were chosen for their value in depressing the shorter cycles and random effects, but were especially of value in almost completely eliminating the double sunspot cycle as all cycles between 18 and 24 years were kept close to zero.

" The amplitude chart lists the seven steps in the smoothing process and shows the effect on all cycles, up to 100 years in length, of the filtering operation used. The curve represents the combined effect of the seven steps used.

" Following is a description of each step:

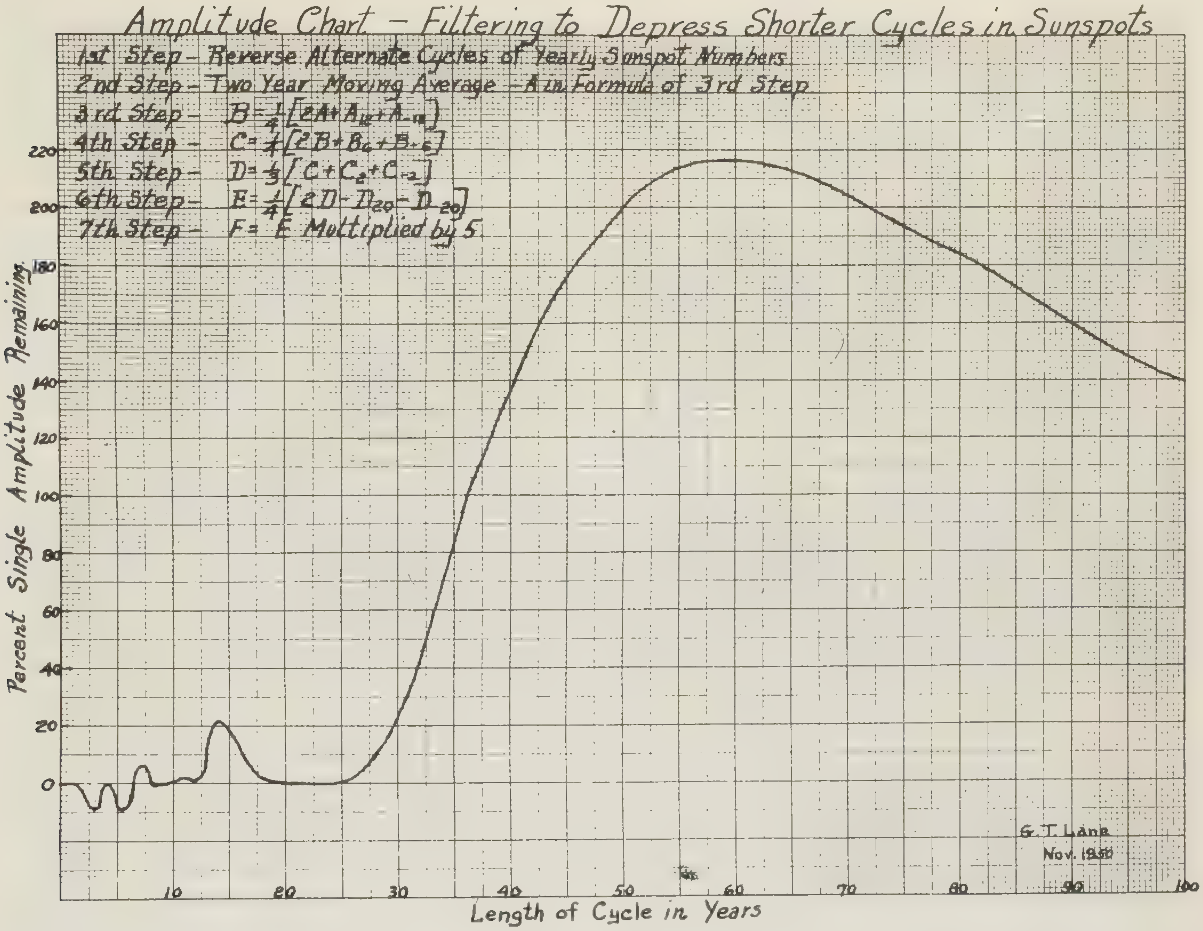
" **1st Step**: Alternate 11-year cycles considered as positive and negative and the yearly sunspot numbers listed as plus or minus.

" **2nd Step**: A two year moving average not centered. Each year of the moving average was considered as January 1 of that year.

" **3rd Step**: Chosen to eliminate a 24-year cycle and depress cycles of nearly that length. A in this formula represents the year being calculated, A_{12} represents the year 12 years later and A_{-12} represents the year 12 years earlier.

" **4th Step**: Values obtained in the third step are called B. This next step, by averaging twice the value of each year obtained in step 3 with the values obtained for 6 years later and 6 years earlier, eliminates a 12-year cycle and depresses cycles near that length.

" **5th Step**: Using values C obtained from the 4th step each year is averaged with the year 2 years later and the year 2



years earlier. This eliminates a 6-year cycle and depresses cycles of nearly that length.

"**6th Step:** This step uses values obtained from the 5th step. From each of these values taken twice it subtracts the values 20 years earlier and 20 years later and divides the result by 4. This step is used to eliminate a 20-year cycle and depress all cycles of near that length. This formula keeps amplitudes near zero for some years each side of 20 years and was used as an added precaution that none of the double sunspot cycles would appear in the final figures. Combined with the other steps this formula gives a zero amplitude for cycles between 20 and 24 years or about the range of the double sunspot cycle.

"**7th Step:** Multiplying the values obtained in the 6th step by 5. This step was taken only after a 36 or 37 year cycle was clear in the values obtained in the 6th step. It was used to bring the amplitude of a 36-year cycle to 100 per cent. Each one of the previous steps had depressed a 36-year cycle to the extent that the combined effect of them was to leave but 20 per cent of the original amplitude. If a 54-year cycle had been found, the figure used to multiply the values of the 6th step would have been 2.33 as about 54 per cent of the amplitude of a 54-year cycle would remain after the first six steps.

"The hump in the amplitude at about 14 years was due to the effect of the 6th step near this point. Thirteen and one third years is the 3rd harmonic of a 40-year cycle. The formula used in Step 6 leaves the amplitude of a 40-year cycle at 100 per cent and the same for all odd harmonics of 40 years. The other steps used in smoothing left a little hump between 13 and 17 years and then multiplying by 5 gave the amplitude of 22 per cent at 14 years. The methods used were chosen to eliminate known cycles. I know of no sunspot cycles averaging between 13 and 17 years.

"While a 37-year cycle seems quite clear it is not uniform. Moreover, there are not equal areas above and below the zero line. This is due to the fact that no effort was made to eliminate longer cycles, that although not apparent in the values as calculated, could, even though very small and unimportant, affect the values of the 37-year cycle. It is possible to eliminate all cycles over 48 years in length, but this would lose 100 years on each end of the series and would use up all the 200 years of sunspot numbers. Any effort to depress longer cycles would lose some years on each end of the series.

"It is of special interest that a 37-year cycle has been noted in the weather and many biological and natural time series. In 1891, Bruckner referred to cycles in harvests, wine making, the freezing of rivers, the water levels of lakes that seemed to follow a period of about 35 years, but the exact length of this cycle has not yet been determined."

Foundation Affairs

NEW MEMBERS, THIRD QUARTER 1951

We are delighted to welcome the following persons and organizations to membership in the Foundation.

July

Alabaster, W. R.
Arnold, T. E.
Besche, A. H.
Bobbe, Henry J.
Brawer, I.
Carson, Joseph E.
Cronin, D. C.
Crush, S. A.
Eby, E.C.
Emrich, George L.
Garth, C. M.
Grodinsky, Julius
Harrower, Gordon
Heffner, Roy J.
Holley, L. R.
Houser, S. O.
Klose, Nelson
Kuhn, E. H.
Langreth, George L.
Levine, William F.
Loeb, Frederick S.
Lovekin, Osgood S.
Merril Lynch, Pierce, Fenner, & Beane
Mott, John C.
Nunnery, R. B.
Parsons, Douglas E.
Pearson, John
Preston, J. H.
Roeder, Samuel
Sandford, John E.
Schuster, M. Lincoln
Stokes, W. E. D.,Jr.
Topp, Clarence A.
Victoreen, John A.
Wallace, Keith K.
Wilson, Dwight E.

August

Anderson, W. A. D.
Arkansas State College
Atkinson, E. W.
Briggs, F. R.
Callahan, R. B.
Chutjian, Levon H.
Ebbitt, Walter D.
Fryling, G. Richard
Gardiner, Everett S.
Hemphill, James
Himmelblau, David M.
Houser, Austin
Institute of the Aeronautical Sciences INC
Llewelyn, Brinley
Mc Kay, R. M.
Malcolm F. Hill
Moorman, L. L.
Orr, William D.
Rockwood, John P.
Stewart, John
Wreden, William P.

September

Abelow, Irving A.
Bearden, H.C.
Boehm, Wm R.
Bowmaster, Ralph W.
Calcord, W. R.
Cherniak, Archie
Cowden, W. H.
Deahl, Albert F.
Fowler, Walter M.
Gouldman, C. C.
Hitchcock, William J.
Huss, Adolph A.
Jones, Vincent C.
Koffitz, Edward J.
Lesko, John
Mc Coy, William C.
Modell, Michael
Moskalek, Simon
Sampson, Leon
Scott, S. A.
Smith, C. P.
Smith, Randolph
Storer, Roscoe R.
Streeter, Thomas W.
Strieby, Richard D.
Sturtrvant, Roy E.
Tolman, Albert W. Jr.
Weitzman, Harry A.

Letters

As I said in our October report, my first contact with Mr. Vedder Hughey, author of the PREDIX charts and a member of the Foundation, came on May 5, 1949, when he wrote in answer to my first quarterly letter to lay members, to say that he was making a section moving average analysis of stock market prices by means of I. B. M. punch cards, that he had several columns on his cards open, and that he would be glad to turn them over to me for scientific work in the event I was interested.

Mr. Hughey's letter

Mr. Hughey's letter is reproduced in full below.

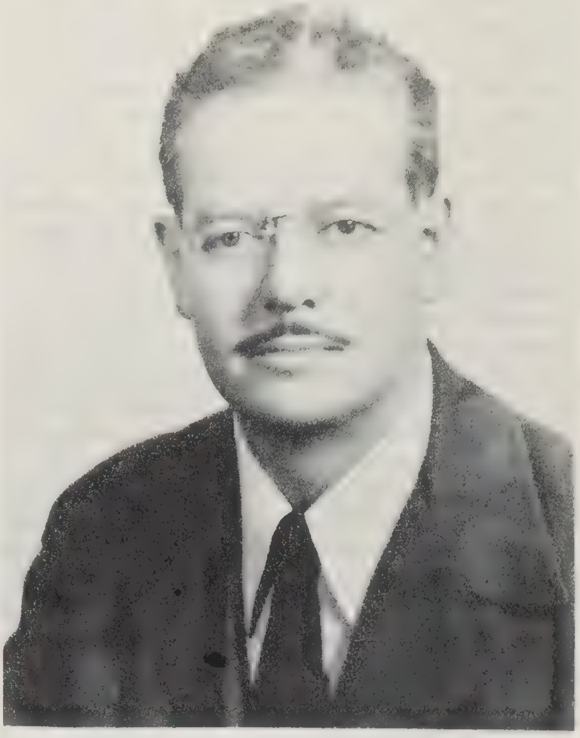
Dear Mr. Dewey:

In belated reply to your most interesting letter of March 23 may I say that I do not recall receiving a questionnaire and would certainly like to know of other associates in the greater Miami area or connected with the University here. I took a master's degree in mathematics many years ago and did teach for one year but then went into business. My interest in technical matters was not revived until I read in Time Magazine of your book on cycles. Since that time I have made a hobby of resuscitating the withered remnants of old brain cells once sharply tuned to matters mathematical, and puzzling over the elements of theoretical statistics.

The problem

The general problem of reducing an economic time series to a set of periodic components with a minimum residue of irreducible random fluctuation seems, at first, not too difficult of precise mathematical solution. Harmonic analysis, since it is essentially a device to convert any arbitrary series into an infinite number of periodic components, does not get at the real problem. This is difficult to explain in exact logical terms, but a little reflection will convince anyone that our problem only has meaning insofar as we can express the major portion of the fluctuations of a series in terms of a finite number of periodic components.

People unfamiliar with mathematics have difficulty in realizing the absolute distinction between the properties of solutions of data-groups having an infinite number of items and those having a finite or limited number of items. To " solve" our problem by means of an expression having an unlimited number of terms is simply to re-state the problem in the language of a related but differently ordered set of data.



Vedder Hughey (Mr. " Predix ") of Coral Gables, Florida.

For a solution to "make sense" the number of terms (periodic components) will also be "small" compared to the number of items in the series. This does not mean, however, that harmonic analysis, with the terms evolved subjected to a further "screening" process, cannot be of direct usefulness. I believe that the components revealed by harmonic analysis, if plotted in terms of amplitude with increasing period, will show maximum points at a relatively few periods; and that a set of such selected components will come close to what we are after.

Not having a Henrici Harmonic Analyzer for rapid reduction of a graph to its first sixty or so harmonic components (Treatment of Experimental Data - Worthing & Geffner p-130) I confidently attacked the general problem from a multitude of alternative mathematical redoubts, principally the calculus of finite differences.

Simplest solution

After a rather extended session of part-time brain wracking, I proved to my own satisfaction that the simplest possible solution consisted of none other than our old friend, section moving average type of analysis. Anyone who has settled for this can rest assured that, however tedious, it is incomparably less tedious than any other possible approach to the problem. A section moving average, carefully selected with regard to possible interfering phenomena, actually comprises a near- perfect "envelope solution" to a host of very arduous "particular solutions", and is indeed the most logical and efficient method of surveying a given series and its potential reduction to periodic components.

Having faced up to this, I embarked upon a program of "scanning" a series with a selected set of section moving averages calculated to reveal periodicities in any neighborhood, at the same time nullifying interfering periodicities outside of this neighborhood, the set of neighborhoods covered being the whole range of possible periodicities. This, I found, is not too difficult to plan, but with a manually operated adding machine and reams of record paper, a rather overwhelming task to execute.

I. B. M. machine to the rescue

Recently, a rather unexpected solution of this latter aspect of the general problem has come my way. The I. B. M. Company has gotten around to opening a Miami Service Bureau, replete with card analysis machinery and advisory service. In consultation with the Bureau, I have adapted their equipment to section-moving-average analysis of series, all but preliminary card punching being straight machine operation.

The Axe-Houghton Common Stock Index (with Clement-Burgess extension)- 1854 to date, comprising 390 items on a quarterly basis, can be set up on punched cards. These can be duplicated by gang punching and sorted by sets. A schedule of discarding first and last parts of successive sets can then be effected so that the remaining cards can be re-sorted into subgroups. These sub-groups, totalling about 18,000 cards, are then run thru their totalizing machine which prints sub-totals, each of which is one of our desired items in a particular section moving average series. In this way some years of individual endeavor are accomplished at the expense of a few minutes and a few dollars.

Several series can be analyzed at once

All this is no doubt an old story to anyone who has attempted to actually do any amount of statistical analysis. The exhilarating thing about the whole business, however, is the fact that, having set up the card analysis to do one series, there remains room on the cards to handle a total of about fourteen series, and the procedure will give analysis data for the whole set of series at no additional expense. So it occured to me that I should explain to you the particular nature of analysis I had decided upon, to-gether with the series being used, and offer to the Foundation the unused space on my I. B. M. cards. This space would allow for the analysis of at least six four-digit series of quarterly data, 1854-1949. Series of shorter duration but more frequent data, i.e. monthly, could be used but with limitations which I will explain below.

Schema followed

After considerable reflection, I decided that the following schema or array of section moving averages would have the following essential properties,-

1) they would reveal in full any periodicities at or close to all known major cycles,

2) they were sufficiently far apart and of sufficient number of terms to nullify periodicities which might exist at adjacent analysis points,

3) they comprised three sets of geometric series, each wave length being half that of the next term of that series; thus lending itself to a very simple method of eliminating the first harmonic (half wave-length) which always appears in any section moving average i.e. an 18-year section moving average will show both the 18-year wave **and** the 9-year wave (and 4 1/2-year, etc.).

The section moving averages used are the ones shown in Table I below.

Table I

7 qtr.	(1¾ yr.)	4 sect.	---	9 qtr.	(2¼ yr.)	4 sect.	---	11 qtr.	(2¾ yr.)	5 sect.
14 qtr.	(3½ yr.)	6 sect.	---	18 qtr.	(4½ yr.)	6 sect.	---	22 qtr.	(5½ yr.)	6 sect.
28 qtr.	(7 yr.)	6 sect.	---	36 qtr.	(9 yr.)	6 sect.	---	44 qtr.	(11 yr.)	6 sect.
56 qtr.	(14 yr.)	5 sect.	---	72 qtr.	(18 yr.)	4 sect.	---	88 qtr.	(22 yr.)	4 sect.

A greater number of sections is not necessary and in the case of the shorter waves needlessly increases computation. In the case of the longer waves, more sections will not leave a sufficiently long period of wave forms to examine.

What will be shown

The 56 quarter section moving average will reveal a rhythm existing at any of the neighborhoods, — 56 qtr., 28 qtr., 14 qtr., and 7 qtr. Now since the 28 quarter section moving average wave will reveal rhythms existing at neighborhoods, — 28 qtr., 14 qtr., and 7 qtr., we can ascertain the true rhythm, if any, existing in the neighborhood of 56 quarters by subtracting the 28 quarter section moving average from the 56 quarter section moving average.

Similarly, we must subtract the 14 quarter section moving average from the 28 quarter section moving average, the 7 from the 14, and apply the same procedure to the other two sets. The complete process will give us the true picture, without harmonic interference, of rhythms existing in the neighborhoods,-7, 9, 11, 14, 18, 22, 28, 36, 44, 56, 72, and 88 quarters. The number of terms in each section moving average will cause rhythms at preceeding and following analysis points to be nullified but will reveal anything existing over ranges about each analysis point calculated to just overlap and hence the set of section moving averages will “ scan ” the whole range of possible periodicities from 1 1/2 to 24 years.

Of course, a wave of length just half way between two analysis points will appear, diminished by about fifty per cent in amplitude, in both adjacent section moving averages. But such a wave can be reconstructed from this evidence in true magnitude, and the location of the set of analysis points (in terms of wave length) should make such intermediate lengths few in number.

Fitting data into the framework desired

The analysis framework described above is admittedly somewhat rigid. It would seem ideal for quarterly data extending back for ninety or so years. If data do not extend back this far, trend values, or zeroes, may be substituted for the early part. The result simply diminishes the section moving average profile, going backward, from full amplitude gradually to zero amplitude; but the true amplitude may be reconstructed from the evidence obtained.

Another and better device is to convert monthly or weekly data to half-quarterly data, thus requiring only forty odd years of data to make full use of the analysis framework. This, of course, gives a set of section moving averages of periods from three and a half quarters to only eleven years but over this range would give a very thoro analysis. The use of monthly data instead of quarterly would give a set of section moving averages of length from seven to eighty-eight months and would seem to be of very limited use. The use of semi-annual data, if it extended back about two hundred years, would work out fine, giving a set of section moving averages of 3 1/2, 4 1/2, 5 1/2, 7, 9, 11, 14, 18, 22, 28, 36, and 44 years period.

The data subjected to such analysis should, except in cases of link relative type of indices, be reduced to logarithms and have the trend removed. Although there is considerable processing required of the data evolved by the I. B. M. machines, such as removing harmonics and idealizing resulting profiles, the main body of tediouswork is done by the machines and at a cost for machine time and cards of as little as ten dollars per series when the cards are completely utilized. Obviously, different series types require different analysis frameworks, but these are not at all difficult to construct once the basic approach is decided upon.

Six series available for study

I have been able to obtain only about six series extending over this period (Axe-Houghton Industrial Stock, Warren-Pearson Wholesale Prices, Roy Wenzlick Real Estate Index, Dun & Bradstreet Insolvency Index, Cleveland Trust Index of Business Activity, and perhaps another one or two). Of special interest are the two indices going back almost twice the period covered. These can be separately analyzed in first and last half sections. Each half can then be used as a forecasting base for the other half, and the correlation between the forecast, developed over an adequate time base, and the ensuing (or preceeding) actual values computed. In the long run, only extensive analysis of this type will establish the degree of validity of periodic analysis.

Any series of data which you believe could be profitably processed by my " analysis framework " described above will be gladly transposed to my punched card set and the results forwarded to you. No compensation for this is contemplated other than the satisfaction of taking some small part in the researches of the Foundation.

Cordially yours,
Vedder Hughey

My reply

In reply I wrote as follows:

Dear Mr. Hughey:

How very thoughtful and generous of you!

Although I once worked out a method of making a harmonic analysis by punch cards, it had never occurred to me that a moving section could be handled that way with great ease, too.

The beauty of a section moving average is that it will reveal rhythms that are not the exact length of the section. And the beauty of the punch card idea is that you could use the cards again for increased separation by using more sections.

I should be very glad indeed to take advantage of your offer to submit for analysis six four-digit series, of 390 terms.

For reasons that I shall explain, I choose the following four series: Relative sunspot-numbers; tree-ring thickness at Fairlee, Vermont; prices of spot cotton at New York; and the Cowles (Standard and Poore's) index of monthly stock market prices. If, for any reason, you do not feel that these series constitute the best use of the space available I can easily choose other series.

Sunspot numbers

I chose relative sunspot-numbers with alternate cycles reversed because the series is homogeneous and because insofar as I have been able to study this series, solar wave lengths and terrestrial wave lengths agree not only in time span but in timing. For instance, in the sun there is a 22.2-year wave that comes in exact reverse phase with a similar wave in wholesale prices; in the sun we have a wave just short of 36 months, and the same thing in stocks; in the sun we have the " 6-year " wave present in barometric pressure, tree rings, common stocks, rayon production, cotton production, cotton prices, automobile production, and in the sales of dozens of industrial firms. Moreover, in cotton prices and the sun this wave breaks down in both instances into two other waves, one about 5.91-years and the other 6.11-years. One hundred ninety eight years of data.

Tree rings

I chose tree rings thicknesses at Fairlee, Vermont, because there is close correspondence with sunspots on the 5.91-year rhythm, and I would like to see if this agrees for other lengths—for example the 22.2-year and the 18.2 and the 17.75-year lengths. I chose this particular series only because I have it conveniently available and because it goes back for about 400 years.

In speaking of sun spots I meant to go on to say that there is a correspondence in the 15-year waves with cattle and paper prices, with the 17 3/4-year waves with cotton prices, sales of certain terrestrial corporations (perhaps the word " terrestrial " was unnecessary); correspondence between the 11-year waves and copper prices, etc. The 18.2-year solar wave corresponds in timing with building and real estate activity, but I do not know the exact length of these waves on earth. As you will doubtless remember, in **Cycles** I called this wave 18-1/3, but subsequent work on the sun shows it there to be slightly shorter.

Cotton prices

I chose cotton prices because I have a complete compound harmonic analysis of cotton prices made some time ago over a period of 210 years. By " compound " harmonic analysis I mean nine or ten complete harmonic analyses (to fifty terms) using successively shorter fundamentals. That is, my first harmonic analysis was on 210 years, the next on 208 years, the next 206 years, etc. This gave values for inbetween the various harmonics so that the length of the **average** waves could be determined with great precision. But of course the method did not prove that there were **rhythms** at these various lengths. That has to be determined separately. It should be interesting to compare the results obtained by each of the two methods, and to compare the results from this series with the results from the solar figures. Finally, the series is homogeneous, and more or less free in its fluctuations.

Monthly stock prices

As for monthly stock prices, I am starting to work on these figures and have a man working with me who will be able to follow through on the supplemental work necessary. Three hundred ninety months is 32 1/2 years, and this is long enough to get a pretty fair picture and one that will tie into your own work. Seven to 88 months would be roughly 1/2 year to 7 1/2 years and will give 12 curves over the range where you have but four, and a number of shorter ones in addition.

Except for interruptions I have been working since the beginning of the year pretty largely on the 6-year rhythm. I would like to get its ears pinned back so that I could say with assurance that it existed here and there and some other place, and that its exact length and timing was thus and so. Sometime I may get this completed.

One of the interruptions was a little study that I made of rayon production. I am sending you a copy under separate cover. It is rather neat the way in which the four rhythms describe the fluctuations from the beginning of this series.

When do you want the four series of figures?

The sunspot figures are going to take a little thought, for they are in the form of plus and minus spots. Have you any suggestions as to how to handle? The other series can be put into logs easily enough-in fact I think I have cotton prices and stock prices in this form already. However, I don't see any need for removing trend. Why not let trend stay in and appear in the moving sections?

By the way, is the section moving average known in the literature anywhere? It is my own invention, but it is so simple that I can hardly believe that many people have not already thought of it. However, I have never seen it referred to.

Besides yourself there are eighteen associates in Florida. I shall have their names sent to you.

Thank you again for your cooperation. I look forward to hearing from you at once in regard to the trend and the deadline.

Cordially yours,
Edward R. Dewey
Director

Additions to the Library

" Cycles Predict the Future, " by Donald G. Cooley, in **Mechanix Illustrated** of April 1944. Gift of the author.

This is the third of a series of articles by Donald G. Cooley describing the manner in which science is learning to foretell the future through the study of cycles. The entire series ran for a period of nine months. Mr. Cooley later reprinted a part of this material in **Predict Your Own Future**, Wilfred Funk, Inc., N. Y., 1950.

● ● ●

" Shortwave Radio Propagation Correlation With Planetary Positions," by J. H. Nelson, reprinted from **RCA Review**, Vol XII, No. I, March 1951, 10 pages, 5 figures. Gift of the author.

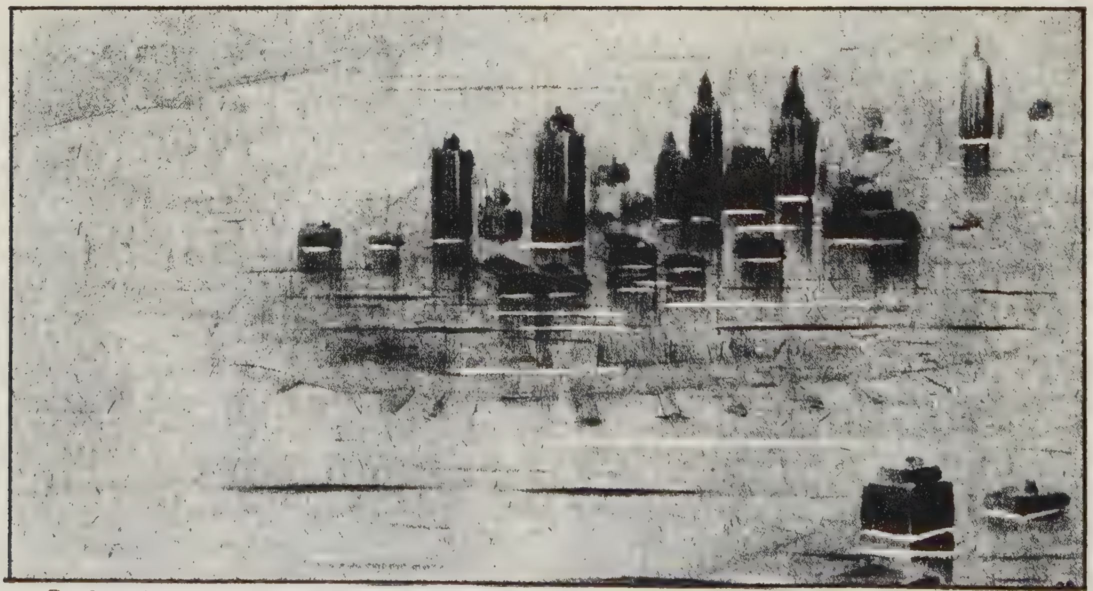
This important paper will be reviewed at length in a forthcoming issue.

" Fluctuation of Forest Animal Populations in East Central Illinois, " by V. E. Shelford, reprinted from **Ecological Monographs**, 21:183-214, April 1951. Thirty-two pages, 18 figures, 5 tables. Gift of Dr. Shelford.

Dr. Shelford is Professor Emeritus of Zoology at the University of Illinois and is the advisor appointed by the Association of American Geographers to the Foundation's committee on awards.

In this paper Dr. Shelford gives the results of extensive counts of some 50 kinds of forest invertebrates such as certain sorts of spiders, herb and shrub ants, mollusks, millipeds, crain flies, and other forest creatures from 1933 through 1947.

The work provides, as far as it goes in time, the raw material for cycle study, but cycles as such are not discussed.



Cycles in weather are very important. A rise in temperature of only 2 degrees would be sufficient to melt all polar ice. This would raise the world's sea levels 150 ft.—enough to inundate Manhattan Island with a shallow sea, put sea bass in Pennsylvania. From " Cycles Predict the Future " by Donald G. Cooley.

QUESTIONNAIRE

FOUNDATION READERSHIP SURVEY

You are invited to express your opinion in regard to our monthly reports so that we can tailor future issues more closely to your needs and desires.

1. It would help me if I knew how you find the style. Specifically, are the reports too technical for you? ...... Too simplified? ...... About right? ...... Do you have any comments? ....

2. Do you like our new cover? ...... Do you like the little summaries we are now placing at the beginning of each article? ...... Do you like the little book reviews? ...... Do you like the pictures we are now beginning to use to illustrate the articles? ...... Shall we discontinue? ...... Continue? ...... Increase their use? ....

3. Would you like a Glossary of Technical Terms printed from time to time? ....

4. Cycles are important in many aspects of natural and social science. Please indicate your **fields of interest**, ranking if you wish.

Astronomy ....
Astrophysics ....
Agronomy ....
Anthropology ....
Archaeology ....
Bacteriology ....
Biology ....
Botany ....
Climatology & Meteorology ....

Dendrochronology ....
Economics ....
  Building Const. ....
  Real Estate ....
  Production ....
  Commodity Prices....
  Security Prices ....
Entomology ....
Forestry ....
Geology ....

Geomagnetism ....
Geophysics ....
Herpetology ....
History ....
  War ....
Hydrology ....
Limnology ....
Mammalogy ....
Medicine ....
Oceanography ....

Ornithology ....
Paleontology ....
Physics ....
Physiology ....
Psychology ....
Seismology ....
Sociology ....
Volcanology ....
Zoology ....
All ....

5. Which **departments** do you like? (Rank if you wish.)

Director's Letter ....
Research ....
Technical ....
Questions & Answers ....
Letters ....

Data ....
Additions to the Library....
Miscellaneous ....
Foundation Affairs ....
  List of Members ....

Ancient Cycles ....
Reprints ....
Basic Data Bulletin....
Technical Bulletin ....
Index at year end ....

I take it that as far as you are concerned we could drop all the departments except the ones you have checked or numbered. Right? ...... Have you any suggestions in regard to other departments you would like to see added? ....

6. Would you be just as happy if we cut down the number of pages from an average of 44 (including covers) to 36 (including covers)? .... Would a report every **other** month suit you as well? ....

7. Here is a list of some of the articles which appeared in the June, September, October, and November reports. **Please check the ones you liked.** (If you are a new member and did not get all these issues strike a line through the reports you have not seen.)

JUNE

Research: The 9.2-Year Cycle in Common Stocks ......
The 9.18-Month Cycle in the Ton-Miles of the C. P. R. ......
Cycles in the Stock Market--A Preliminary Projection to 1990 ......
The 22-Year Cycle in the Advt. Efficiency of the Pinkham Medicine Co. ......
The 18 1/3-Year Cycle in Building Construction ......

Ancient Cycles ......

Technical: Limitations of the Periodogram ......
Techniques involved in the 9.2-Year Cycle in Stocks
Construction of the Charles H. Pinkham Index of Advt. Efficiency ......

Data: Prices 1933-1950 in Terms of Gold ......

SEPTEMBER

Research: The Synthesis of Long Cycles in Stock Prices ......
Sunspots Before 1750 ......
The 19.4-Year Cycle in Railroad Stock Prices ......

Technical: Techniques Involved in the Synthesis of Stock Price Cycles ......
Techniques Involved in the 19.4-Year Cycle in Stocks ......

OCTOBER

Research: The 37-Year Cycle ...... and 1. The 37-Year Cycle in the Variation in the Length of Time Between Sunspot Maxima, 301 A. D. ......
Stock Market Cycles by PREDIX ......

Reprint: Technical Bulletin No. 4, " Cycle Analysis: The Moving Average ......

NOVEMBER

Research: The 41-Month Cycle in Industrial Common Stock Prices ......
The 700-Year Cycle in Japanese Weather ......
The 37-Year Cycle in Sunspot Numbers ......

Technical: Techniques involved in the isolation of the 41-Month Cycle in Stocks ......
Techniques used to isolate the 37-Year Cycle in Sunspot Numbers ......

Please fill out these pages, sign, tear out, and mail to Edward R. Dewey, Foundation for the Study of Cycles, East Brady, Pennsylvania. Please do it now while you think of it. If you put it off you know what will happen!

Name................................
Address.............................
....

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CYCLES — A Monthly Report is published by the Foundation for the Study of Cycles every month except during July and August at the Foundation's offices at 9 East 77th Street, New York 21, N. Y. Subscription rates $10.00 a year. Entered as second class matter at the Post Office at New York, N. Y. Letters for the personal attention of the Director should be sent to East Brady, Pennsylvania.

A SPECIAL LETTER TO OUR JUNE AND JULY TRIAL MEMBERS:-

You sent in $2.00 in June or July for a trial membership in the Foundation. This trial membership gave you the June, September and October reports, and now brings you the November report.

Under postal regulations we cannot mail you any more reports until you tell us you wish to become a regular member. I hope you want to become a regular member and that you let us know that you do.

What you will get

As a regular member during the coming year you will get four things:

1. You will get 10 monthly reports. Because our pages are so big this is the equal of two full sized books. I shall tell you below about some of the material we hope to print during the coming year.
2. You will get the privelege of attending meetings of members. The next meeting is scheduled for sometime in January of 1952 in New York City. I plan to be the speaker and will discuss cycles in the stock market. See our December report for details.
3. You will get the privelege of attending an " institute " to be held in your own city (if there are enough people in your city who want it to make such an institute possible) in order to learn how to detect, isolate, and project cycles. The institute will be held afternoons and evenings so as to interfere as little as possible with your regular business. There will be a charge for attending, depending upon the number of persons who want to come. Look for details in future reports.
4. And finally, you will have the satisfaction of helping to carry on this important form of research, for it is only through the dollars contributed by you and other like-minded people that the work goes on.

Future reports

Going back to the matter of our monthly reports, during the coming year we plan to include at least one article about cycles in common stocks in every issue. What want to do is to go back over our ea work of 1944 and refine it and add tc and come up with a revised project which will reflect, as well as may be c with our present knowledge, the proba future composite effect of the cyc which can be isolated. We want to inc discussion of short term cycles as w as discussion of long term cycles.

We also plan to publish the result a complete multiple harmonic analysi common stock prices, to be made jus soon as the machine is available. It show **all** the cycles from five month which are present on the average in t figures.

During the coming year we plan to complete the series of articles on the 37-year cycle which, as you know, has been found in 12 different phenomena.

We also plan articles about cycles in weather, cycles in general business, cycles in abundance of animals, cycles in disease, cycles in commodity prices, and cycles in many other aspects of natural and social phenomena; also, of course, the other miscellaneous departments with which you are already familiar.

If you have ideas for the improvement of our reports let me know. Use the questionnaire on the last two pages of this report, or write me a letter.

Do it now!

And now, if you want to become a regular member, be a good fellow and let us know **now**! Send us a letter or a postal card or use the coupon below. Thanks a million!

Cordially yours,

Edward R. Dewey
Director

P. S. If you are a September trial member don't be bashful. You too can use this form.

- -

Foundation for the Study of Cycles
9 East 77th Street,
New York, New York.

Of course I want to be a regular member!

☐ Bill me $10 for a full year starting with the end of my trial membership,

or, ☐ Credit my $2 toward a retroactive regular membership and bill me $8.

Sincerely yours,

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